Engineering News-Record

A Consolidation of Engineering News and Engineering Record
McGRAW-HILL PUBLISHING COMPANY, INC.
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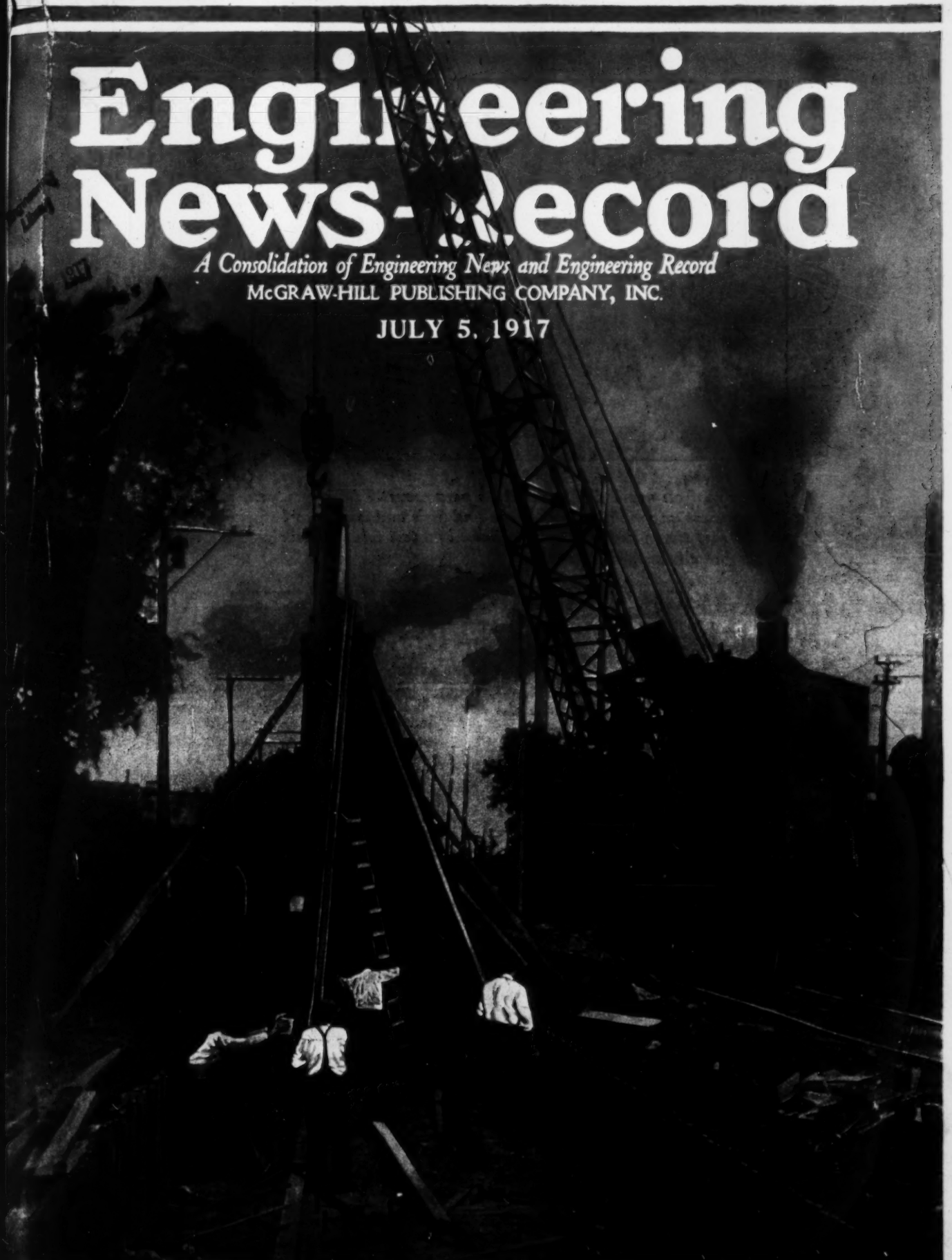

Track Elevation for the Chicago, Milwaukee & St. Paul, at Chicago, Will Probably Be Finished This Year

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"For Flat or Pitched Surfaces."

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"The Indestructible Roof"

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

Volume 79 — NEW YORK, JULY 5, 1917 — Number 1

The News-Record's New Type Dress

WITH this, the first number of the new half-yearly volume, *Engineering News-Record* appears in a new typographical dress. By the use of Century, a type of bolder face than that formerly employed, the characteristic "grayness" of the old pages is replaced by a stronger tone. In fact, the main object of the change was to produce a paper whose typographical make-up would, as nearly as possible, reflect the strength and virility of the men who read it. The editors will feel that their work has been well done if the *News-Record*, in its new form, makes its weekly message to engineers and contractors more inviting and forceful.

Prompt Pay for Government Contracts

THE desirability of prompt payment for contract work done for the Government in the present emergency has been recognized by both the War and the Navy Departments. Statements have been issued by the quartermaster general to the effect that action has been taken to insure prompt payment to all contractors furnishing work to the Government, and by the Navy Department to the effect that all obligations will be settled promptly and that the department will appreciate a complaint giving the facts in any case where payment may be delayed. This will not only be welcome news to many contractors, but will insure more prompt and efficient work for the Government by taking the contractor's mind off the subject of his personal credit and allowing him to devote all his energy to the work in hand. It is a wise move, and the departments are certain not to regret making it.

Refreshing Event in the Technical Year

THE convention of the American Society for Testing Materials is, without doubt, one of the definitely refreshing events in the technical year. Organized by engineers for the purpose of developing and standardizing methods of tests and for investigating the properties of materials intended for commercial and engineering use, the society has developed until now it is looked upon by engineers and the consuming public as the one source of reliable and authentic information concerning the desirable qualities of materials. This fact is not lost sight of by the manufacturers. That the meetings are attended by manufacturers to such a point that sometimes the original character of the society is lost is not to be regretted, but rather should be taken as a most healthy sign of the society's usefulness. More than one manufacturer has confessed that the sins of the commercial world, of which policy has demanded the abandonment, are being consciously atoned for by the most refreshing sort of frankness and willingness to coöperate with testing engineers and the buying public. It remains for the consumer to continue to be alert in the consideration of reports in order to preserve the proper balance on which the whole life of the society depends.

Society Meetings Should Not Be Postponed

THE record attendance at the meeting of the American Society for Testing Materials last week is proof positive of the good judgment of the Executive Committee in not yielding to the current pressure to call off all technical meetings for the period of the war. This species of hysteria has attacked several of the important technical societies whose work is vital to the business needs of the country. Such meetings as the summer session of the American Society of Civil Engineers can well be dispensed with, for they were at best vacation trips in company with congenial spirits, but an engineering society which holds meetings of so little importance to its members that it can readily put off one of them for a year may well look into the wisdom of having such meetings at all.

Saving at the Spillway and Losing Whole Dam

ANOTHER example of saving at the spillway at the cost of the dam is afforded by the washing out of the Mammoth reservoir dam in Utah last week, described on page 42. True, this dam had not been carried to its full intended height, so there was extra temptation to rely on a makeshift spillway. True also, the temptation to store more water for crops in this time of world need led to still other risks, one of which was the use of flashboards in the makeshift spillway. But all the temptations and excuses in the world will not enable anyone successfully to defy the forces of nature and engineering fundamentals. So for lack of a spillway and because of an attempt to store more water at increase of an already large risk, all the water was lost, the dam was ruined, miles of railway and many railway bridges were swept away, railway traffic was suspended, coal mines had to shut down, and manufacturing industries were threatened with coal famine. Whatever the extenuating circumstances, the roaring waters have once more sounded a warning against saving at the spillway and losing the whole dam.

The Magnetic Testing of Steel

ALTHOUGH Prof. M. A. Howe pointed out to the American Society for Testing Materials last week that magnetic testing of steel products is in its infancy as yet, that is hardly a stable criticism, undeniable as its truth may be at the present moment. Perhaps neither Professor Howe nor those who offered similar remarks intended to call into question the findings of such men as Burrows, Devries, Lasier and Fahy; but the residue of the discussion was unfortunate, for there was left a distinct impression that the method is receiving overmuch emphasis, is suffering from special pleading at the hands of men too near to it to preserve a proper perspective. Now, when a method or an idea is being used in commercial practice, when success is attending its employment for the purpose of separating good from inferior products, to cast any more than a mere shade of doubt upon its broader applicability presupposes evidence pointing to definite failure in many specific instances.

This last the opponents of the one really new thing brought out at the recent convention of the society failed to do. They merely pointed out that certain classes of researches demand the old method of testing. This is not denied by the proponents of magnetic testing. They feel that in the new method there is so much of value that, even though it cannot entirely supplant the microscope and the testing machine, still there is a wide field which can be covered only by some such method as that brought out by Professor Burrows. They overlooked, too, the fact that in much engineering the testing of samples is of practically no value. To instance merely drain tile, wherein the failure of one length in place invalidates the whole job, is sufficient. Likewise, one ball in an important bearing might easily result in the destruction of an immensely costly piece of machinery. It will not do simply to laugh magnetic testing out of court. Its antagonists must accept it as an additional and highly valuable tool as yet not fully developed.

Anybody for Inspector

THE claim that anybody is qualified to inspect construction work on public contracts was put forward again—it is an old claim—in a recent small-town dispute over contract matters. The idea is one apt to be advanced by political officials, as it supports them in placing men of any kind on the inspection force.

Do such officials really believe that inspection requires no knowledge of the subject? *Engineering News-Record* asks this question with every desire to be fair. We recognize the honesty of the argument sometimes made: That mere watching is required; that the specifications set forth in detail what work is to be done, and that nothing more is required than to enforce performance by clerical process. But anyone who is even slightly familiar with engineering construction knows the fundamental error of this argument.

On construction work there are many chances for improper methods and procedure in the delivery and use of materials, backfilling trenches, mixing and placing concrete, culling bricks, etc. Apart from dishonesty or incompetence, foremen and crews may be careless and negligent, exercise bad judgment, try to speed up work or use some makeshift plan to cover an emergency defect, without considering that this will tend to produce bad work and that it may even be detrimental to the interests of their employer. It is obvious that an inspector who simply looks on without understanding what is being done or what should be done is of little use in preventing bad work, whether done intentionally or unintentionally.

Inspection is a necessary, responsible part of civil engineering work. It calls into play sound engineering judgment, based on both knowledge and experience. To undervalue its importance or its technical character constitutes not only an error likely to have bad consequences, but also it is an injustice to the many able men engaged in inspection service. Let us hope there are few, if any, engineers in this day and generation who are inclined to look down on the inspector as an unimportant hireling not worthy to be classed as a member of the profession. Let inspectors be credited with the status appropriate to their functions. It will then be a mere matter of agitation and education to get equal recognition from all public officials.

Hard Steel for Columns

NOW that the dependence of column strength on compressive yield-point, or "hardness," of the metal is brought to notice, the question forcibly presents itself whether economy will not warrant adopting harder steel for columns. Steel of somewhat higher carbon than ordinary bridge steel, produced just as cheaply, will show a yield-point 10,000 or 15,000 lb. higher and will produce columns stronger by the same amount. The resulting economy is obvious.

How carefully this argument must be confined to compression members does not need to be specially pointed out to the structural engineer. Nothing is more definitely and vitally shown by all experience in bridge and other steel construction than the fact that due safety is dependent on the use of ductile steel. For that matter anyone, be he engineer or not, can appreciate that toughness is a primary reliance in any structure. But the critical points where tough, ductile material is required are the tension members and those connections and parts which are subjected to bending stresses and irregular deformation.

Columns under normal conditions are exposed to a service where brittleness is virtually eliminated as a danger element. Hard steel can be used in them with no decrease of safety. The advantage of high yield-point strength may be secured without the disadvantage of brittleness to detract from the gain.

It may appear like turning back the clock a long way to suggest in this day a departure from one uniform quality of structural steel and the establishment of two grades, one tough and one hard. But though the proposal may seem strange, it is likely that there would be no fatal objection raised by either steelmaker or engineer. The fabricating shop alone has good grounds for opposing the introduction of hard steel. A large increase in the amount of drilling of rivet holes would be required if extensive use were to be made of the new grade. In view of the steady extension of

drilling in regular bridge practice, however, this objection has at best only temporary force. It cannot permanently stand in the way of hard steel if the latter can carry out its promise of considerable saving of metal.

The Railroads Must Still Wait

WHEN *Engineering News-Record* a few weeks ago pointed out the new responsibility thrust by the war upon utility managers and commissions to settle grave problems quickly and correctly, a reader was prompt to give assurance that the commissions, at least, would rise to all emergencies as they came. Yet the strongest commission of them all, the Interstate Commerce Commission, at the very first opportunity, seems to have failed grievously. Asking for a 15% blanket increase in freight rates, the railroads are denied anything more than small increases in certain class rates. The commission, conducting its hearings with almost the same deliberation as characterized them before the war, and giving no decision until two days before the new schedules were to go into effect—this silence until the eleventh hour of itself involving the railroads in a large amount of unnecessary clerical labor—is unable to perceive that there is any emergency. If net earnings drop as predicted the matter can be taken up anew Oct. 28.

Perhaps the carriers took too much for granted. Possibly they did not present sufficient proof that we are at war and cannot foresee the future, that our present prosperity is on a rather precarious footing, and that the prices of everything except transportation have gone up; also that last summer the railway brotherhoods threatened a nation-wide strike unless they were granted large increases in pay, that in appeasing them with the Adamson law the President gave fairly definite assurances that the carriers would be allowed to make up the added costs by higher rates, and that these added costs became a reality six months before the date set by the carriers for the increased rates. But surely these things were all within the knowledge of the commission, and have more bearing on the equity of the case than any quantity of statistics that may have been produced.

Commissioner Harlan, who voted with the majority to prevent a deadlock, while believing the commission was falling far short, sizes the situation up clearly in a separate report. He says in part:

"This month-to-month and purely statistical view of the matter seems to me to be wholly inadequate. Nor do I regard that course as altogether safe. We are facing a much larger problem, and it must be approached in a much broader way if we are to reach a sound solution. The report of the commission states that some of the symptoms disclosed of record are unquestionably unfavorable. . . . That . . . being so, the wisdom of deferring full relief is not apparent to me."

Certainly the present unprecedented business the railroads are handling, which may end as suddenly as it began, should not be the criterion as to whether or not the railroads can earn a fair return on their fair value, and furthermore, the public owes it to them to make good the added expense of the Adamson law.

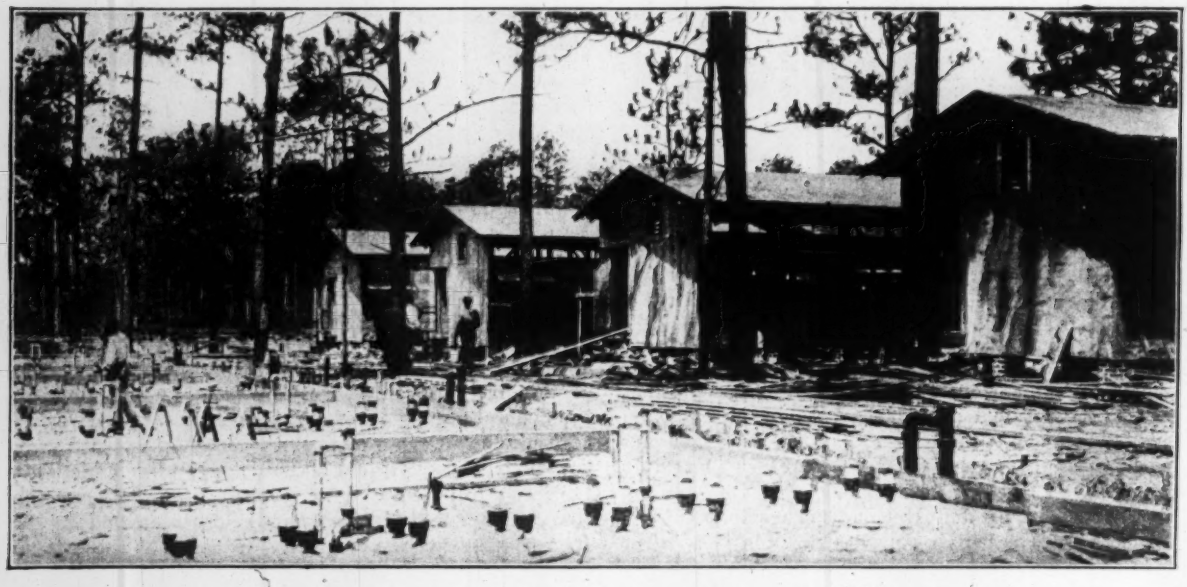
Percentage Contracts for the Navy

IN URGENT work, required for national emergency, time is the most valuable single factor. It is therefore gratifying to note that agencies of both the Army and Navy Departments have found it possible to break away from the delays incident to competitive bidding and to award contracts for construction more quickly and directly on a percentage basis.

Since the Bureau of Yards and Docks took the lead under Admiral Harris, its chief, last year by adopting a form of straight contract that made it possible for contractors to bid with more certainty and with greater assurance of fair treatment than on work handled by any but a few of the best civilian engineers, it is also gratifying to find this bureau adopting an addendum to the general provisions of its standard contract covering percentage work in a manner thoroughly in accord with the spirit of the original documents. In this addendum the items to be covered by "cost of the work" and the items of expense to be borne by the contractor out of his 10% commission are so clearly defined that there is no chance for either party to claim a misunderstanding. The document is drawn so that the contractor cannot lose unless he fails to deliver the goods. It is drawn so that the Government cannot lose through any act or claim of the contractor. This is simply and effectively accomplished by setting forth in plain language what each party is to do. The bureau assumes all risk incident to unforeseen changes of plan. The contractor has complete assurance that, if he furnishes the structures he is directed to furnish on time and completed in a satisfactory manner, the cost will be paid him by the Government.

In addition, provisions are inserted so that, in case of unusually difficult work where plant rental and overhead expense might not be compensated by the 10% fee, the contract may be drawn to include one or more such overhead charges in the cost of the work. If subcontracts are required, the general contractor must let them for a lump sum, which is then considered part of the cost of the work, but on which the general contractor is paid only a 5% fee. This covers his responsibility and expense in connection with the subcontract. The items included in the cost of the work and in the things to be covered by the 10% fee are so balanced that, while the contractor will not have to rely on a profitable general business to support the Government work he may undertake, he cannot, on the other hand, make any excessive profit on his Government contracts. He is aided in financing the work, however, by prompt monthly payments in full. The retained-percentage clause is dropped in exchange for one enabling the Government to pay the contractor in full and dismiss him at any time the work is evidently falling below the requirements contemplated in the contract.

At a time when the urgency of the situation might be held to excuse much confusion, Admiral Harris is more than ever to be congratulated on handling this percentage work in a manner that could scarcely be improved on for efficiency, even in times of peace and calm. This form of contract will save the country much money on the work of the bureau by making it possible to secure the best of services and to put work through without the delay of misunderstandings and disputes.



THE BARRACK BUILDINGS EACH ACCOMMODATE 25 MEN—LAVATORY-BUILDING CONNECTIONS IN THE FOREGROUND

Housing the Navy Ashore

Wood Cantonments at Charleston, S. C., Planned for Units of 1000 Men—Local Contractors Pool Interests on Rush Construction—First Unit Complete in Three Weeks

PLANS for housing the new army while in training, under conditions which have necessitated a departure from the familiar tented camp, are similar in general scope to those which have confronted the navy in its present state of sudden and pronounced expansion. Circumstances are such as to necessitate a radical departure from the traditional practice of quartering naval recruits aboard receiving ships, these being entirely inadequate to accommodate the numbers of men now enlisting for the fleet. The following notes are descriptive of a cantonment designed to house not less than 5000 men at the naval station at Charleston, S. C., which has heretofore been able to quarter all recruits and casuals aboard the "Hartford," formerly Admiral Farragut's flagship, but latterly used as a receiving ship at the Charleston yard.

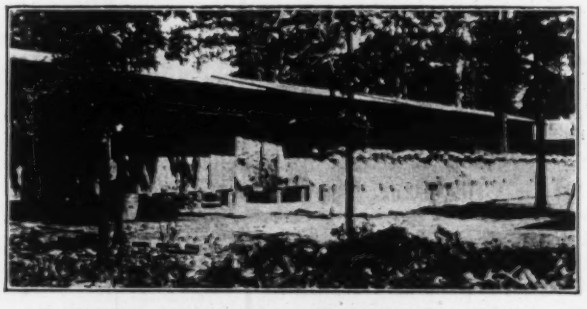
Advantages of the Camp Site

The site selected for the cantonment is a level sandy stretch of pineland, fairly well covered with first-growth long-leaf yellow pine. It lies partly within and partly without the limits of the naval reservation, a circumstance that has simplified the problems of water-supply, sewage disposal and illumination of the camp. It has been necessary merely to make suitable connections with the respective navy-yard services. Transportation also presents no special difficulty, as the site is on the line of the Seaboard Ry. and is connected with Charleston, some 10 miles distant, by electric railway and by highway, which is paved with Belgian block for all but a mile or so nearest the camp.

The layout of the cantonment is based on an administrative unit, or "regiment," of 1000 enlisted men of all grades including petty officers, but not including the proper complement of commissioned personnel. The entire cantonment will therefore consist of five units, or regimental camps, of which the following description represents the type plan.

For convenience of administration the regiment is divided into 10 companies, each subdivided into four sections of approximately three squads each. To be exact, 25 men compose a squad. To house a regiment, 40 small detached wooden barracks are provided, each housing a complete section. A combined mess hall and kitchen, a latrine and lavatory building, an administration building and a small building for the chief petty officers complete the unit camp.

The 40 barrack buildings are arranged on opposite sides of the latrine-lavatory building in two symmetri-



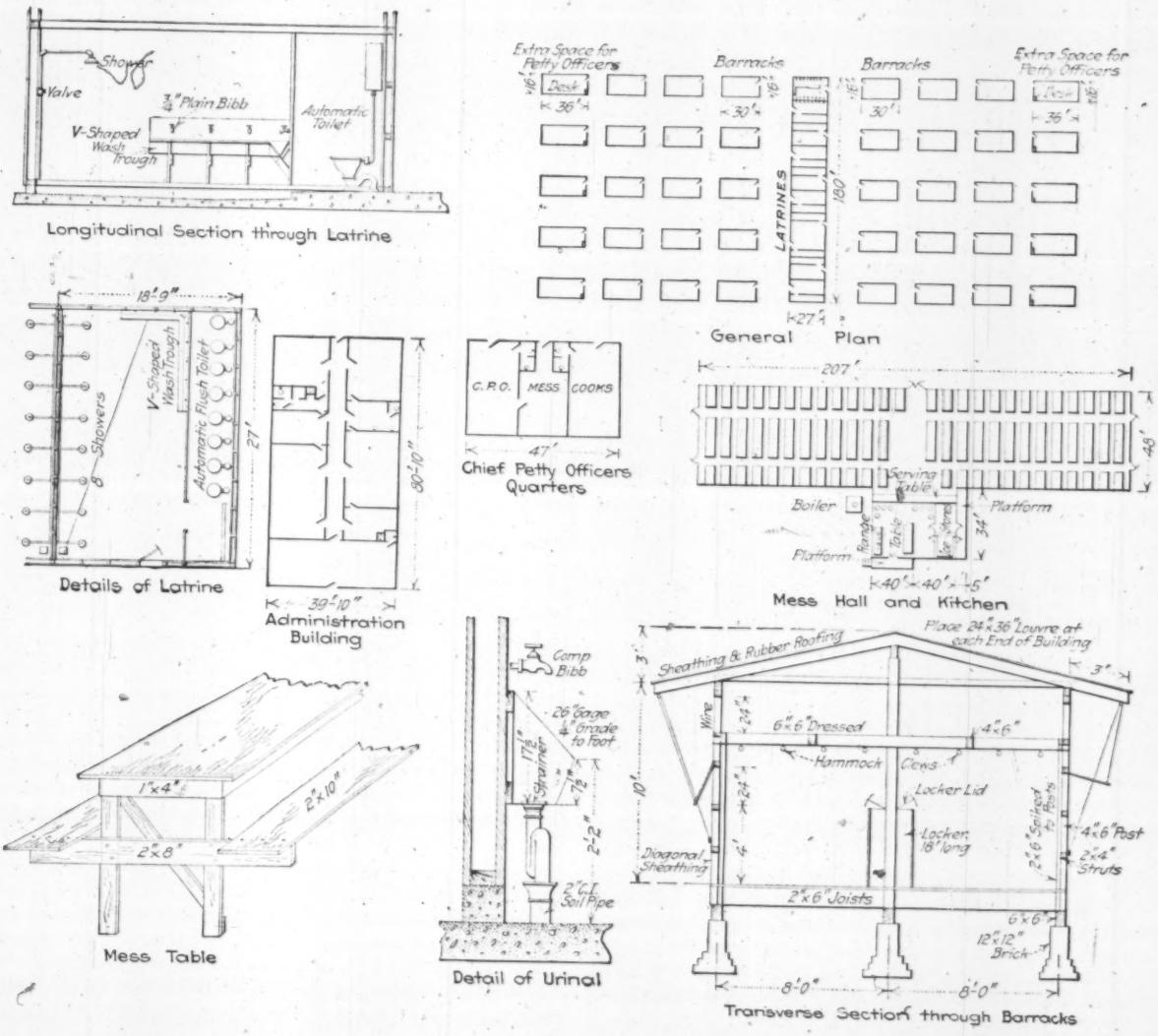
TO HOUSE A REGIMENT 40 OF THESE BARRACK BUILDINGS ARE REQUIRED

cal groups of five rows of four houses, placed end to end in each row. These houses are separated from each other by about 30 ft. in the clear. The three inner barrack buildings in each row measure 16 x 30 ft. in plan, while the outer building in each row has an additional 6 ft. in length as a concession to the petty officers, who are thus quartered on the flanks of their respective companies. A company occupies the four barracks in each row.

These small buildings are all on brick piers at least 18 in. in height above ground, and they measure 10 ft. from the bottom of the sill to the top of the wall plate. The roof is of the ordinary gable type, with a pitch of 3 in. to the foot. In either end is an ordinary slatted ventilator, or louver; and the building has but one door, which is placed in a corner in that end of the building nearest the latrine. The eaves overhang by 3 ft. No glazed windows are provided, but immediately under the eaves the walls on both sides and for the full length of the building are open to a depth of 22 in., with no provision whatever at present for closing this space.

About 1 ft. below this opening is another of the same depth, running the full length of the building on either side, but this may be closed by a series of panels, each about 6 ft. in length, hinged at the upper side. These panels are adjustable by means of a small line fastened to the lower edge of each and passing over a small sheave fastened at the outer end of a rafter, thence to a cleat placed at a convenient height on the wall. With the approach of cold weather, both of these openings may be fitted with sash, which can be either fixed or arranged to slide on runners.

The entire building is sheathed up with a fair quality of sheathing, that on the walls being placed diagonally for greater rigidity. The roof is covered by four-ply roofing paper of good quality, and it is worthy of note that the side walls are also fully



A FEW CONSTRUCTION DETAILS OF THE NAVY-CAMP BUILDINGS AT CHARLESTON, S. C.

covered by a lighter weight of high-grade roofing paper, carefully nailed on. If necessary for the preservation of this roofing material, it may be given an occasional coating of light protective paint. The ventilators in the gables, the openings in the side walls, and the doors are all screened with a good grade of galvanized screen wire, and the roofing-paper sheathing on the walls not only serves to keep out wind and driving rain, but is an absolute safeguard against flies, mosquitoes and other insect pests.

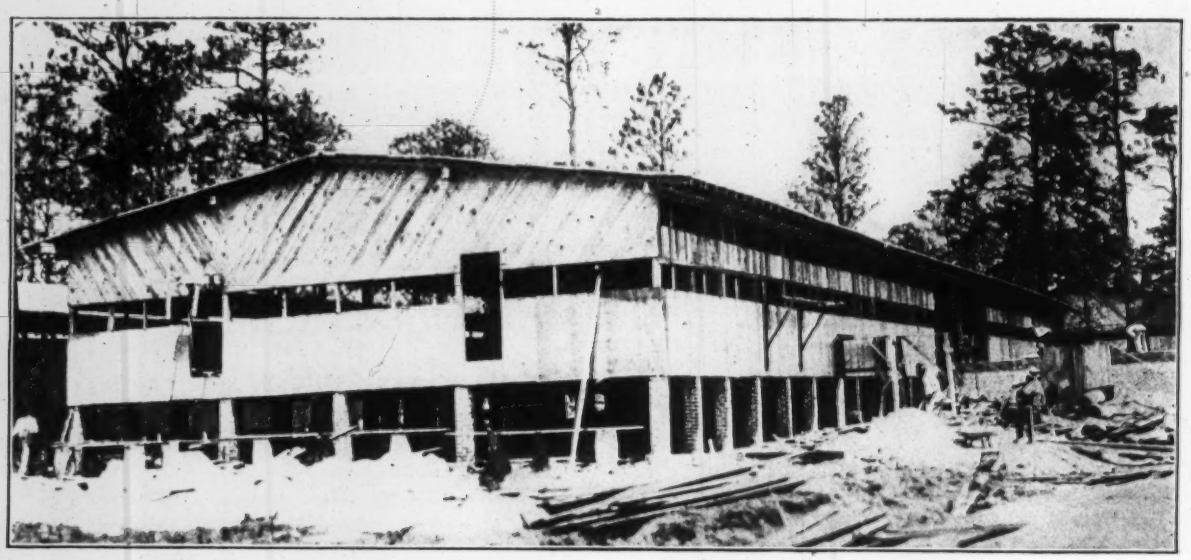
Hammocks Instead of Bunks

No cots or bunks are provided, but the interior framing is so laid out and provided with hooks or clews as to facilitate the swinging of the usual sailors' sleeping hammock. In this way is the fledging bluejacket given a "taste of the salt," while at the same time the limited floor space is kept available for use by day. The hammocks are swung from alternate crossbeams in such a way that the head of each hammock is opposite the middle of its neighbor on either side.

To provide storage for hammocks and clothing, each building contains down the center a series of lockers or narrow chests opening at the top and provided with rails in the interior, over which the hammocks and clothing are hung. In each building, at the end opposite the door, is a set of "pigeon-holes," each large enough to take a duffel-bag not too generously filled. Your true sailor is not encumbered with an excess of baggage.

Between the two groups of 20 houses and at right angles to their ridge-lines is a combined latrine, shower-bath and lavatory building 27 x 180 ft., partitioned off into 10 compartments. These compartments are again subdivided by low partitions to form a latrine and a combined bathroom and washroom. One such compartment is assigned to each company, and the entrances are arranged alternately on opposite sides of the building. All of these compartments have concrete floors, pitched to drain through a proper floor-trap into the sewers. For each 100 men, eight wash-bibbs, eight showers and eight toilets are provided. The wash basin is merely a zinc-lined trough to catch the water from the eight spigots, it being expected that the men will use running water for washing, though tin basins may be supplied later if found advisable to reduce the waste of water.

In the earlier buildings, which were needed at once and for which suitable fixtures could not be had without delay, the urinal and the toilet consisted of merely a zinc-lined trough, the latter provided with suitable seats, flushed periodically by a heavy stream of water entering at one end and draining at the other. As was anticipated, objections to this primitive contrivance developed almost at once, and later buildings will be equipped with individual toilets of an efficient but economical factory type, operated in the usual manner by a spring when the weight is removed from the seat.



THE WALLS OF THE MESS HALL AND KITCHEN ARE TO BE SHEATHED WITH ROOFING PAPER AND ALL OPENINGS COVERED WITH GALVANIZED WIRE-CLOTH SCREENS

For each regiment of 1000 men a single mess hall and kitchen is erected at a suitable distance from the squad rooms and latrine building. The mess hall proper is 48 x 207 ft. in plan, with a kitchen 30 x 34 ft. opening off the middle on one side. The mess tables are of the well-known logging-camp style (seats attached) and are all 30 in. wide with seats 10 in. wide, suitably supported. There are 25 tables down the center, which will accommodate 20 men each, and 25 tables on each side to accommodate 10 men each, at the liberal rate of 2 ft. of space per man. Main aisles and passageways between tables are commodious and permit rapid service without confusion or risk of accident by collision of waiters.

The cooking equipment is virtually that of a ship's galley brought ashore and consists of eight or more steam cookers of 50 to 80 gal. capacity each and a 16-ft. coal range for roasting meat, baking and such other culinary operations as cannot be conducted by a steam cooker. The necessary steam is supplied by a 25-hp. boiler set up outside the building. Opening off the kitchen is an ice-box or refrigerator room 10 x 14 ft. in plan and about 6 ft. in height inside, built in place, with double walls of tongue-and-groove lumber, the

space between being packed with sawdust or planing-mill shavings to give proper insulation. The interior is zinc lined. Adjoining the ice-box is a storage room, also 10 x 14 ft. In the newer buildings the kitchens all have concrete floors, draining to a suitable floor-trap, which connects with the sewers.

Can Feed 1000 Men in 20 Minutes

The mess management is identical with that aboard the larger vessels of the navy, and details need not be discussed here, except to say that it differs from that of the army, where the mess unit is a company, and the company commander, assisted by a mess sergeant, is charged with the messing of his company, as well as its instruction, discipline and other multifarious details. In this navy cantonment the system will permit feeding the 1000 men in 20 min., should there be any necessity for such quick action.

On one flank of the mess hall is an administration building partitioned off into office rooms for the use of the officers, examining surgeons and others administering the cantonment. At the opposite end of the mess hall is a building for the accommodation of the chief petty officers, who assist in duties of training and administration.

In addition to the buildings above mentioned, separate quarters will be provided for the cooks; and an emergency hospital will be built, which will not only accommodate the inmates of the cantonment, but other casuals sent ashore from the fleet.

Local Contractors Pool Interests

As in the case of the other cantonments built or building, the first unit was a "hurry-up" job, without time to make any comprehensive study or to prepare plans or layout. The leading contractors of Charleston were called to the yard one morning, and the results to be obtained and the guiding principle to be followed were placed before them for consideration. Each contractor was requested to submit before nightfall a lay-out of the camp and type plan for buildings, with a bid for the construction of the first regimental camp. As a result of a conference held later between the officials of the yard and the contractors, the latter decided to pool their interests, plant and personnel. Work was virtually begun on the following day; and the first unit was complete within three weeks at a cost of about $33,000, which includes everything except the links necessary to connect the camp water-supply, sewerage and lighting systems with those of the navy yard proper. This is a per capita charge of $33 for the first 1000 men to be accommodated, but the four regimental units now building will be completed at a considerable reduction and in much less time per unit.

Cost $33 per Man

While this cost, $33 per man, appears to be rather high, it is not greatly in excess of the per capita charge for tented camps, and the comfort and security of the men against insect pests are much better in these wooden buildings than in the canvas shelters. Further, the wooden barrack has a much longer life than that of the canvas tent and has a sale value at the conclusion of the camp greatly in excess of that of canvas. In this particular cantonment the buildings are of such size as to permit their being moved bodily, and two or three can be consolidated and fitted out with verandas to form a very attractive bungalow. It is not improbable, in fact, that these wooden barracks will help to solve the problem that now confronts the navy-yard officials and the City of Charleston in respect to housing the employees of the yard during ordinary peace conditions.

The contractors on this work are the Simons-Mayrant Co., the Charleston Engineering and Contracting Co., McCrady Brothers & Cheves, and P. D. Hay. Mr. Stevenson, of the Charleston Engineering and Contracting Co., has served as general manager for the allied contractors. The work has been prosecuted under the direction of the commandant of the navy yard, Capt. B. C. Bryan, with Commander F. Morrison, captain of the yard, in immediate charge, assisted by Civil Engineer P. L. Reed, public-works officer.

Oil and Coal Costs Compared

Table Shows That One Ton of Coal Is Equivalent in Heating Value to 3.34 Barrels of Oil at 325 Pounds

One ton (2000 lb.) of coal is equivalent in practical heating value to 3.34 bbl. of oil at 325 lb. The table below compares the prices of coal and oil for equivalent cost as fuel in a boiler furnace:

Coal, per Ton (2000 Lb.)	Oil, per Bbl.		Coal, per Ton (2000 Lb.)	Oil, per Bbl.	
$5.00	$1.50	$1.66†	$3.25	$0.98	$1.01
4.75	1.43	1.60	3.00	.90	1.00
4.50	1.35	1.50	2.75	.83	.92
4.25	1.28	1.42	2.50	.75	.83
4.00	1.20	1.33	2.25	.68	.75
3.75	1.13	1.25	2.00	.60	.66
3.50	1.05	1.02			

* Not allowing for labor saving. † Assuming 10% of cost of fuel in labor of firing and handling ashes saved by using oil, a conservative estimate for plant of over 300 horsepower.

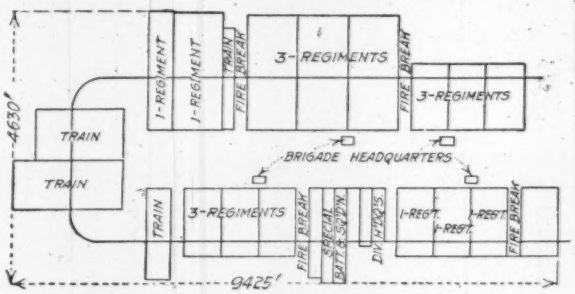
An interesting point to notice is that the heat value of an oil usually given is the high heat value, or heat value determined in a bomb calorimeter. The actual heat value available in a boiler furnace is less, because all fuel oil contains a considerable percentage of hydrogen, and the latent heat of the steam formed by the combustion of this hydrogen passes up the stack as waste heat.

In all the heavier grades of fuel, particularly the Mexican oils, water mixed with the oil is in the form of an emulsion and will not settle out in a tank, as it will with the lighter American crudes. This is not so much a disadvantage as it would seem other than causing a lowering of the heat value. With an oil light enough for the water to settle out of its own accord, this water will frequently accumulate in the tank and piping and go over into the burners in a slug, putting the burners out; but with heavy oil a very considerable amount of water can go through the burner with no bad effect. The writer is inclined to believe that a small quantity of water in heavy oil is an advantage in that these oils are usually heated above the boiling point of water to effect atomization, and the vaporizing of the moisture in the oil as it leaves the burner tip probably helps to atomize the oil more thoroughly.—B. S. Nelson, *Journal* of the American Society of Mechanical Engineers, June, 1917.

Plans for Army's Big Training Camps Made Public

System Perfected for Handling and Checking Rush Deliveries of Vast Quantities of Materials—Labor Pay To Be Limited

EFFECTIVELY localized responsibility is a feature of the system developed by the quartermaster general's office at Washington for handling the work of building the 16 cantonments for the National Army. The organization is under direction of a constructing quartermaster, who is aided by a military guard officer, and an engineer force working under a consulting engineer, an expert on water and sewerage problems, and, in some instances, an expert on town planning. To this organization the task of building each camp city is intrusted with full authority, under typical building plans drawn at Washington. Modification of the cantonment layout to suit the local topography is left to the local organization. Sewerage and water-supply plans are also developed locally, the typical design made at Washington being only a general guide. The road construction is not yet provided for.



THIS IS A SUGGESTED ARRANGEMENT OF THE STANDARD CANTONMENT WHERE CONDITIONS PERMIT

Preparatory Work

Railroad spurs or sidings must be built from the nearest main line, at railroad cost. After completion of the cantonment the railroad is not to form part of its transportation system, however, and the sidings are to be removed.

Rush delivery of materials will be secured by (1) filing copies of material-order certificates with the Car Service Committee of the American Railway Association and (2) using shippers' waybill envelopes indicating that the shipment is for Government use.

To get assured check on quantity and quality of lumber, the principal material, a double inspection is provided for this material. Inspection of quantity and quality will be made at the mill, and quantity will again be checked on receiving the lumber at the site.

The fire danger in this camp work calls for early consideration. Before any material is delivered, all brush, rubbish and dry grass must be cleared and burned for 300 ft. distant from all storage and building sites. Water casks and fire pails must be distributed and a patrol established at the start; also, signal systems and calls for the fire departments of near-by towns must be established. Later, fire companies with their own apparatus are to be organized. Smoking, fires, open lights, etc., will be limited by special rules.

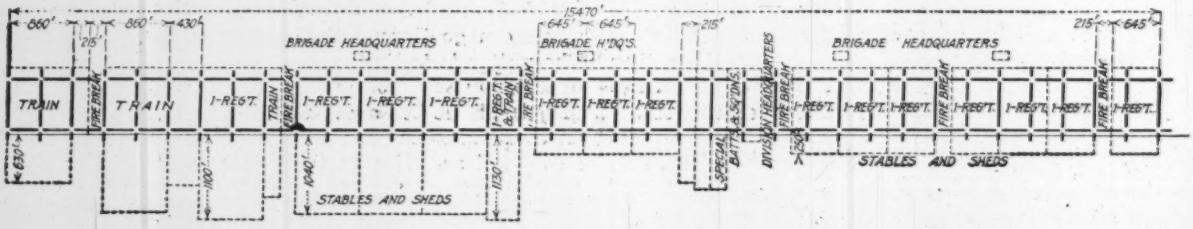
The rate of pay for labor shall, *as a general rule*, not exceed the union scale prevailing in the particular locality on June 1, 1917. Arrangements for working hours and overtime are at the discretion of the constructing quartermaster and the contractor. Subcontracting is not looked on with favor and will require special approval.

The barracks for one regiment may, as soon as built, be used to house the contractor's labor forces, with restrictions as to use and subsequent cleansing and fumigation.

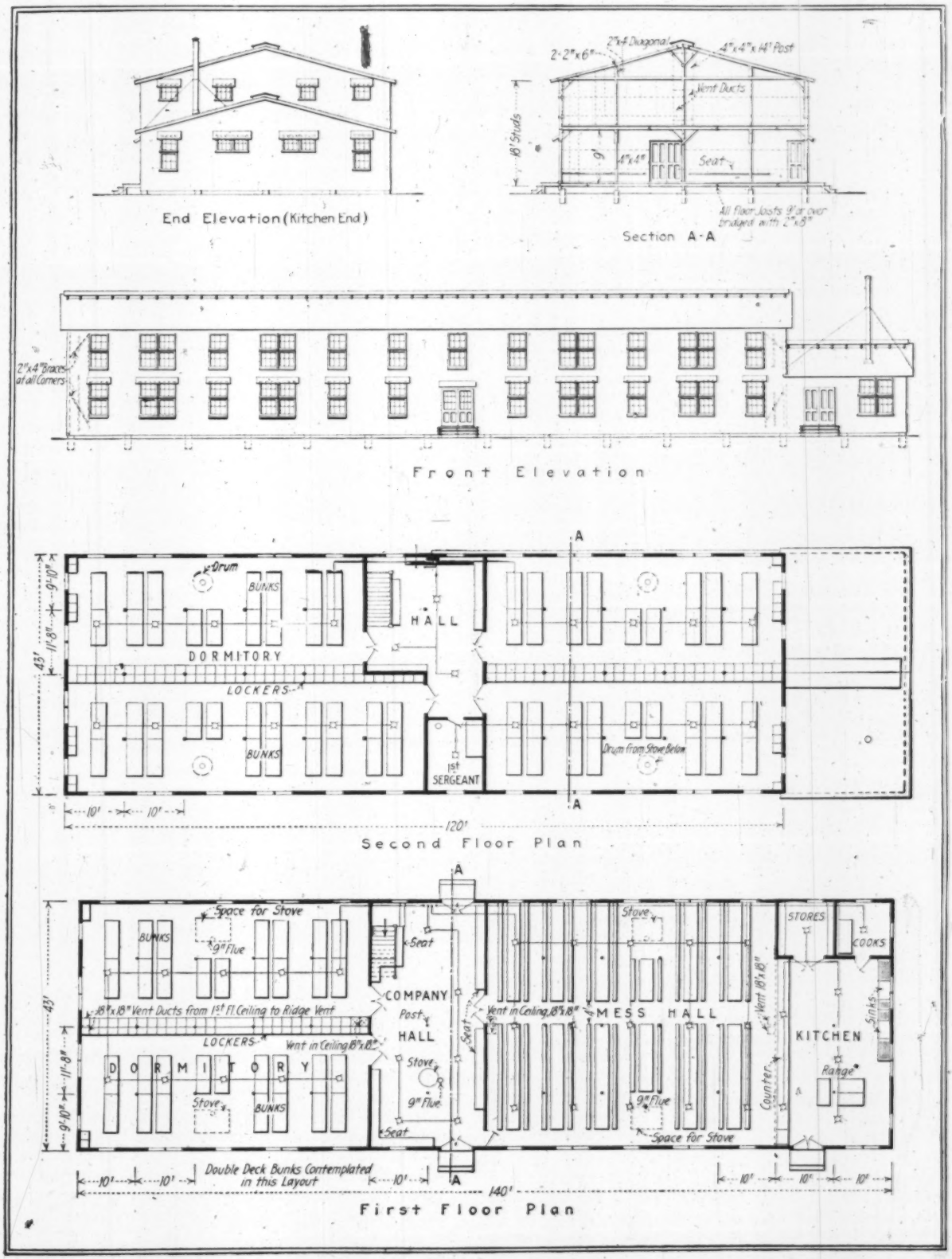
To keep the Washington headquarters in close touch with the work, each constructing quartermaster is to make a daily telegraphic report and a weekly written report, the latter reviewing the work of the week comprehensively and including graphical charts of material receipt and construction progress in the several classes of work.

A field auditor will check the orders and bills. Bill duplicates will be checked by his force on delivery of material; later the duplicate invoices are to be checked against them and finally the original invoice substituted. Very detailed routine has been established for this, for employment records, time cards and related items of the accounting work. The effect of this systematization is to render the central control at Washington as simple as practicable with work so extensive and done under such high pressure as this cantonment construction.

Payments to contractors are to be made about the ninth of each month regularly, and as often during the months as deliveries justify. A system of financial correspondence by telegraph has been arranged to enable Washington to supply the local office with funds daily, if required.



STANDARD CANTONMENT LAID OUT ON STRAIGHT LINE EXTENDS OVER THREE MILES



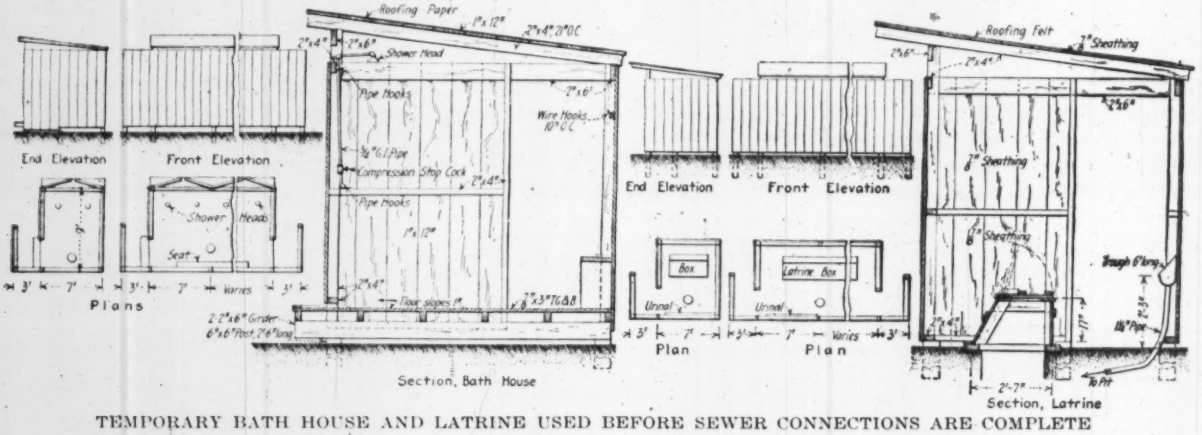
COMPLETE LAYOUT OF A STANDARD COMPANY BARRACKS. MEN BOTH SLEEP AND EAT IN THIS WOODEN FRAME BUILDING

Buildings Will Be Simple Wooden Structures

The drawings herewith show typical arrangement and construction of the buildings of the cantonment. The barracks, two stories high, contain each its own kitchen and messroom. Lavatory buildings are separate.

The lines of buildings will be interrupted by 300-ft. fire breaks spaced about 2100 ft. apart. The roofs of buildings are required to be of metal or other fire-resisting material, and the side boarding must give a 15-in. clear space above ground or be carried down to the ground all round. If paint is used, it must be a cold-water paint of some fire-resisting quality. Storage buildings and the like will be metal clad. Inflammable materials will be stored in detached buildings, 150 ft. from other buildings if storing over 75 bbl. of oil. Gasoline in quantities over 15 gal. will be stored in underground tanks.

Fire stations equipped with motor fire apparatus will be provided, usually four per cantonment, or so located that no building is more than a mile away from a fire station. One fire station will be placed in or near the hospital group.



TEMPORARY BATH HOUSE AND LATRINE USED BEFORE SEWER CONNECTIONS ARE COMPLETE

Water-Supply and Sewerage

The problems of water and sewerage will have to be worked out by the constructing quartermaster with his assisting experts. The intended supply capacity is 55 gal. per capita per day, but the one-hour supply rate must be about 150 gal. per capita per day; the normal pressure is 60 to 85 lb. per sq.in. Two 10-in. or 12-in. mains through the length of the site will be required in most cases. Wood-stave pipe of the machine-wound type is contemplated, with curves and specials of cast or wrought iron. Storage is to be provided (if minimum amount, 1,000,000 gal. capacity low-level or 300,000 gal. high-level).

The sites will be drained by open ditches. The sewer system is for sanitary sewage only. To give double assurance against entry of water into the sewers, the water pipes are to be laid in separate trenches, and the connection of specials is to be made with deep or wide sockets. All sewers are vitrified salt-glazed pipe, sizes 6 in. to 30 in., laid on gradients not less than 0.005 for 6 in. and 0.0007 for 30 in.; the joints are 1:2 cement mortar, except that deep-socket joints are calked with hemp or jute and then poured with hot compound. Deep-socket pipe is to be used in wet ground and in wooded areas. All sewers except outfalls are to have manholes at 300- to 500-ft. spacing.

The sewage is to be discharged into adjacent streams untreated, wherever possible. Where treatment is required, single-story septic tanks either wood or concrete are to be built, with gross capacity 10 gal. per capita. At Ayer (Mass.) and Wrightstown (N. J.), sand filtration may be used; in some other locations sprinkling filters are likely to be added to the tanks. Automatic chlorinating plants are called for, except where the system has sand filters.

No provision for electric wiring has been made so far. Laundries are also not in the plans; the use of civilian laundries is counted on, for the first. The barracks are to be heated by stoves in the lower story, with smoke pipes extending through the second story and the roof.

To Charge Counties for Convict Labor Supplied by State of New Jersey

Upon request of Governor Edge, the State Highway Commission, New Jersey, is considering the adoption of a plan for defraying the cost of convict labor employed for county-road construction on a percentage basis between the state and different counties. Heretofore the state has been donating this class of labor for public-road work, regardless of locality, with an average expense of $1.45 a day for each man from prison, in addition to providing the apportioned state aid for the particular highway improvement, totaling 40% of the cost of construction. Calling the attention of the commission to this existing plan of state-road operation, the Governor says: "The employment of convict labor has simply been in the shape of a gift from the state to the county, meaning that in addition to giving 40% as state aid for new highways we are giving this entire cost of the use of convicts on the roads, which in my judgment is not equitable and an obligation which the state should not assume in addition." It is suggested to the commission that this arrangement for road construction be modified with a suitable and satisfactory plan allowing the state to continue to extend the 40% share of road cost, less the amount that should be credited by the county for the employment and use of the convicts.

Testing Materials Meeting Greatest in Its Twenty Years' Existence

War Conditions Have No Effect on Attendance or Interest in Specifications and Papers—General Bixby the New President—Joint Concrete Committee's Report Attacked

DESPITE war conditions and notwithstanding the fact that there were no "fighting specifications" to be ratified, the 20th annual meeting of the American Society for Testing Materials, held at Atlantic City the week of June 25, surpassed all attendance records. The total registration was 569 members and guests as against 513 for 1916, which was the previous record year. In a year when many societies are omitting their annual meetings for fear of lack of interest this is a remarkable tribute to the practical appeal of the American Society for Testing Materials, to the fact that it is a business necessity to manufacturing and consuming interests.

The war, with its immense increase in the consumption of many of the materials standardized by the Society, has not as yet reacted on specifications or committee activities, at least as reported. There were some properly veiled references to steel qualities as demanded by military authorities, vague rumors of the cessation of committee work for the period of the war and occasional comment on the effect of the war on producing or testing conditions, but for the most part it was evident that the making and improving of material specifications is proceeding in a normal and progressive manner.

Committee Work as Great as Ever

While the technical committees occupied their usual dominant position on the program, discussions of their reports were less vigorous than usual, which was due partly to the routine nature of the specifications presented but mainly to the excellent work in preparing the specifications. As has been pointed out before this year, the committees now so largely embrace the best talent on each subject and the members present at meetings have so consistently demanded approximate unanimity of committees on reports, that these reports more and more tend to approach a result acceptable to all interested. That this was true at the recent meeting is shown by the fact that of the 57 specifications and recommendations submitted, only one was rejected by the meeting. That was the specification for Wood Paving Blocks which was rejected because of irregularities in subcommittee make-up, as detailed further along in this report.

The sessions were admirably conducted by the President, A. A. Stevenson (Standard Steel Works Co., Philadelphia), with the aid of C. L. Warwick, the Assistant Secretary, who served in the absence of Prof. Edgar Marburg. Professor Marburg is recovering from a serious illness and is under physician's orders to refrain from such arduous duties as the secretarial work of the Society just before and during the convention involves. A telegram hoping for his speedy recovery was the first order of business of the convention. The evening devoted to the presidential address and the reception was amplified by a celebration of the 20th birthday of the Society, in which all the living past-presidents participated. Interest in all of the early sessions was consistently good, but toward the end the specialized subjects assigned there resulted in decidedly reduced attendance. The executive committee might well consider the better balancing of the program, with the view of preventing this gradual reduction in attendance.

A well-attended golf tournament on one afternoon was the main entertainment feature of the week.

Some Items of General Society Interest

Some matters of general interest to Society procedure were brought forward. It was decided that tentative standards, in the odd years when no Yearbook is published, shall be printed together in one binding for the members and also printed in the "Proceedings." The executive committee announced that the pressure in Washington had acted to delay the translation of the specifications announced last year, but that work was well under way and could be expected to proceed. The suggested addition of the word American to the standard portland-cement specifications was deemed not wise by the executive committee, and the specification will be named in accord with other standards of the Society. A discussion on the report of Committee C-2, transmitting the final report by the Joint Committee on Concrete and Reinforced Concrete, led to the submission and adoption of a resolution—of the meeting only—that the Executive Committee attempt the formulation of some rules governing the conduct of joint committees, both within the society and between the Society and other societies.

Financially and numerically the Society is flourishing and maintaining its gradual increase. For the ensuing year Gen. W. H. Bixby, retired U. S. A., was elected president and Prof. Edward Orton (Columbus, Ohio) the new vice president. Professor Marburg, it was announced, was continued by the executive committee as secretary-treasurer.

Fifty-Seven Specifications Submitted

There were submitted by committees 4 new standards, 31 new tentative standards, 18 revisions of standards to be published as tentative and 4 revisions of tentative standards. The new standards are Tests for Paint Thinners Other Than Turpentine, Tests for Shellac, Methods for Routine Analysis of White Pigments, all submitted by Committee D-10, and Methods for Sampling and Analysis of Creosote oil or Other Preservative Oils, by Committee D-7. The other specifications will be taken up under their subjects.

Committee A-1 on Steel presented its usual voluminous report, but with fewer vital recommendations

than is common. C. D. Young (Pennsylvania R.R.), who has been chairman for some years, resigned at the end of this year's meeting because of a change of his duties which prevent him from keeping in close touch with the progress in testing and specifications. The committee's recommended specifications were all adopted by the meeting to send to letter ballot. None were of exceptional interest or caused any controversy except the new Tentative Specifications on Tieplates and on Carbon Tool Steel. The former was objected to by Capt. R. W. Hunt (Chicago) because in his opinion it was "absolutely impracticable" and not in accordance with the practice of producer or demand of consumer. The objections to the tool-steel specification were that it was for chemical requirements only, which do not give an indication of what the service of the steel will be. The committee agreed that the specification was highly tentative, but advanced it as a desirable start. The meeting supported the committee in both instances. Other specifications of the committee related to minor changes in forgings, locomotive and automobile parts, boiler tubes, etc.

Cast Iron and Wrought Iron Have Few Changes

Committee A-3 on Cast Iron (Richard Moldenke, Watchung, N. J., chairman) had two new tentative specifications, on Cast-Iron Soil Pipe and Fittings and Railroad Malleable Iron Castings. The former has been demanded for some years and never before accomplished; the latter is in answer to increasingly urgent needs and is the forerunner of some promised analogous specifications particularly for conveyor-chain links. Two comparatively unimportant revisions on standards were also submitted.

The important work of Committee A-3 on Wrought Iron (S. V. Hunnings, Washington, D. C., chairman) was the recommendation that in the future separate specifications will be made for all wrought-iron products now classified with steel specifications in the Society standards. As a start there was offered a new Tentative Specification for Wrought-Iron Pipe—a product hitherto included in the specification for welded steel and wrought-iron pipe.

Committee A-4 on Heat Treatment of Iron and Steel submitted answers to several questions put by Committee A-1, but on motion of a member of the committee who stated that some of the committee were not in agreement with the printed answers, the report was referred back to the committee. Committee A-5 on Corrosion of Iron and Steel (S. S. Voorhees, Washington, D. C., chairman) reported the progress on its test panels of corrosion tests and the results of comparative investigations of the determination of zinc in galvanized coatings.

No New Specifications for Cement

Committee C-1 on Cement (Russell S. Greenman, Albany, chairman), which for years has been a center of interest and controversy, has settled down following the adoption last year of the Standard Specifications for Portland Cement and reported only progress. This progress is toward the preparation of standard compression tests and of specifications for natural cement. Committee C-9 on Concrete and Concrete Aggregates (S. E. Thompson, Boston, chairman) while not presenting any specifications, submitted two very valuable and progressive recommendations. The first comprised suggested methods for making and testing field specimens of concrete and reduces to a practical working basis the technique of a comparatively new but very useful testing procedure. The methods are not submitted as final but rather as suggestions based on the limited available information. The second part of the report is given over to suggested calorimetric tests for organic impurities in sand, a unique and workable test developed recently in the Lewis Institute in Chicago.

Joint Committee on Concrete Criticized

The other concrete committee—C-2 on Reinforced Concrete (F. E. Turneaure, chairman)—submitted the Final Report of the Joint Committee on Concrete and Reinforced Concrete, "which is the result of the joint efforts of its own members and of the representatives of other societies appointed for the same purpose." The Secretary, R. L. Humphrey, announced that the committee now had under consideration the preparation of specifications for reinforced concrete, using the Joint Committee report as a basis, that report being distinctly stated not to be a specification. The committee intends to invite its colleague committees on the Joint Committee to join in this work. After two written discussions on minor points, the Joint Committee's report was attacked by R. J. Wig (U. S. Bureau of Standards) as an altogether too optimistic document from the construction and wear viewpoint. Mr. Wig offered no criticism of the design features of the report, but he contended that the sections on methods and adaptability of reinforced concrete did not take account of many of the known deficiencies in concrete and in consequence failed to present a true exposition of its qualities and possibilities. Such members of the committee as admitted Mr. Wig's premises claimed that the information on which he based his criticism was more recent than the report, which is dated July 1, 1916.

Little attempt was made to discuss the criticisms themselves, however, as controversy over the disposition of the report soon arose. An attempt was made first to accept none of the report, and later only that part relating to design, but representations that a Joint Committee report—particularly one which has been in public circulation for five months—could not be treated so cavalierly, overcame whatever opposition there was to the report itself, and it was accepted as a report of Committee C-2 and ordered printed, with the request that Mr. Wig specify his criticisms in a written discussion. The controversy, however, led to the recommendation on joint committees noted earlier.

Clay and Cement Sewer Pipe Separate

Committee C-4 on Clay and Cement Sewer Pipe (Rudolph Hering, New York, chairman) had meetings subsequent to the preprinting of its report, at which some changes in the four specifications presented this year were made. At these meetings there evidently had been an effort made to combine in one specification the two now separately presented for Clay Sewer Pipe and Cement Concrete Sewer Pipe respectively. The action of the committee is somewhat obscure and was not cleared up at the society meeting. The result seems to be, however, that the two specifica-

ns are to be submitted separately to letter ballot but that the committee considers that they ought to be voted. Two further tentative specifications were proposed and accepted by the meeting—for Recommended Practice for Laying Sewer Pipe and for Required Crushing Strengths of Pipe To Carry Loads for Ditch Filling, the latter being changed in title from that appearing in the preprint.

Committee C-5 on Fireproofing (Ira H. Woolson, New York City, chairman) presented the standard time-temperature curve for testing already brought before the National Fire Protection Association, as noted in *Engineering News-Record* May 31, 1917, p. 435, and amended the present Standard Test for Fireproof Floor Construction and for Fireproof Partition Construction in accordance with this curve and to meet the views of a joint conference which has been held by those societies interested in fire protection.

New Tentative Specifications for Masons' Lime were presented by Committee C-7 (J. S. MacGregor, New York City, chairman). These are to take the place of the present lime specifications in so far as structural lime use is concerned. It is hoped in the coming year to make new specifications for agricultural and chemical uses of lime. Some very elaborate tests of hollow tile construction, tests which give good base figures from which to figure the strength of walls of this material, were part of the report of Committee C-10 on Hollow Building Tile (L. H. Provine, chairman). No new specifications were submitted.

Wood Block Specification Irregular

The one specification of any sort which was not accepted by the meeting—and hence will not go to letter ballot for approval—was that on Wooden Paving Block submitted by Committee D-7 on Timber (Herman von Schrenk, St. Louis, chairman). This specification stated to be the joint production of representatives of various societies, is the same as was adopted by the American Wood Preservers Association in January, 1917, but has been amended (to avoid a recent patent) from the specification adopted September, 1916, by the American Society of Municipal Improvements and received, January, 1917, by the American Society of Civil Engineers. The specification was presented to Committee D-7 by its subcommittee IV and was voted on by the main committee as follows: Affirmative, 25; negative, 2; not voting, 7.

Discussions submitted to the meeting of the Society objected strenuously to the specification, mainly on the ground that it promoted a monopoly, inasmuch as only one producer could meet the specification. This claim did not reach refutation because it was submitted that the subcommittee making the report was made up of five producers to one consumer, in contravention to the rules on regulation of committees. President Stevenson, who was in the chair, thereupon ruled that the specification—and all of the report emanating from this subcommittee—would have to be thrown out unless the meeting by a majority vote waived the regulation. The vote was put and the waiver defeated, whereupon the chairman ruled out this part of the report.

A second part of the committee's report related to the amendment of the Tentative Methods for Sampling and Analysis of Cresote Oil, for which a nine-tenths vote of those present was asked so that these specifications could legally be submitted to letter ballot as standards. With the addition to the title of the words "Or Other Preservative Oils" this specification was accepted by unanimous vote so that it now goes to the letter ballot as a standard.

Dampproofing vs. Waterproofing

In the discussion of the report of Committee D-8 on Waterproofing (W. A. Aiken, New York, chairman) some disagreement among members of the committee present at the meeting as to the use of the terms "dampproofing" and "waterproofing," delayed progress for a while, but finally the four specifications submitted were approved, with changes of title in cases, so that they now are to be submitted as tentative specifications on "Asphalt for Use in Dampproofing and Waterproofing," "Primer for Use with Asphalt for Dampproofing and Waterproofing," "Coal-Tar Pitch for Use in Dampproofing and Waterproofing" and "Creosote Oil for Priming Coat with Coal-Tar Pitch for Dampproofing and Waterproofing."

Committee D-4 on Road Materials (Logan W. Page, Washington, D. C., chairman) contributed three tentative specifications on toughness of rock, tests for specific gravity of coarse aggregate and methods for distillation of bituminous material for road treatment, as well as some new definitions of terms used in road building.

The following committees submitted specifications dealing with specialized branches of their subjects: B-2 on Non-Ferrous Metals and Alloys, C-8 on Refractories, D-1 on Preservative Coatings, D-2 on Lubricants, D-9 on Electric Insulation, D-11 on Rubber Products and D-10 on Shipping Containers. All were approved by the meeting. Committees C-6 on Drain Tile, D-13 on Textiles and E-3 on Pipe Threads presented progress reports but no specifications. Committee E-4 on Magnification Scales for Micrographs established tentative standards for microphotographic work. Committee E-1 on Methods of Test changed the Standard Methods of Testing so that the speed of testing is no longer noted as inconsequential, but it is restricted within certain stated limits.

Although 29 papers were on the program and most of them were read, in abstract, by the authors, the discussion developed little of additional interest. A number of the papers are abstracted on another page of this issue.

Illinois Has $7,000,000 for Roads

For roadwork in Illinois this year there will be more than $7,000,000 available, according to a statement by S. E. Bradt, secretary of the State Highway Commission. This amount appropriated by the legislature includes $1,326,000 to meet the Federal allotment and $1,200,000 for state-aid work, while there is an unexpected balance of $1,174,000, making $3,700,000 in all. The Federal Government will grant $1,326,000, and the several counties must make appropriations aggregating the sum of the unexpected balance and the state-aid appropriation. The grand total is $7,400,000. A new law in Illinois makes a considerable increase in license fees for automobiles, and the amount raised in this way will meet the state's appropriation for roads.

Materials and Methods of Tests Discussed at Annual Convention

Wide Range of Subjects Presented at Last Week's Meeting of the American Society for Testing Materials, at Atlantic City—Abstracts of Some of the Papers Given Below

The following are abstracts of papers presented last week at the annual meeting of the American Society for Testing Materials held in Atlantic City, N. J.:

What Controls Rock Toughness?

The variation in results noted in tests made on duplicate samples by several laboratories led F. H. Jackson, Jr., to investigate the effect of controllable variables on the toughness test for rock. Employing the Page impact testing machine, he found that it is extremely necessary to watch the direction of drilling with reference to possible planes of weakness in the material, variations in the character of the rock from point to point in the quarry, and slight variations in the diameter and height of the specimen.

Grain Size in Ingot Iron

B. J. McAdam, Jr., described some observations and experiments on "Admiralty metal" and on cold-wrought ingot iron. After a preliminary treatment to produce a small grain size, which was then followed by a varying reduction in thickness and annealing at different temperatures, he found that ingot iron has a "recrystallization range" of temperature extending from about 900° to 1475° F. In this range, the grain size for any definite amount of previous deformation seems to be independent of the temperature and to depend only on the amount of deformation. The smaller the deformation, however, the higher the temperature necessary to produce recrystallization.

A Method of Comparing Different Cement-Lime Mortars

Warren E. Emley, of the United States Bureau of Standards, has investigated the properties of a number of variations in cement- and lime-content mortars and prepared diagrams by which the relative properties of different kinds of mortars may be determined, using the familiar triaxial diagram. Four methods of proportioning mortars are first graphically represented on triaxial diagrams laid out on tracing-cloth sheets. These four methods give the determination of the percentage of lime by (1) weight of cement added, (2) weight of cement substituted, (3) volume of cement added and (4) volume of cement substituted. Then 45 mortars of varying proportions were each tested to determine the following properties: Percentage of water for normal consistency, soundness, time of set, yield, cost per cubic foot of mortar, compressive strength at 7 days in air, 6 months in air, 6 months in water, and tensile strength 6 months in air and 6 months in water. Using the same triaxial diagrams, these tests were plotted for each property investigated, and contour lines were drawn on the diagram indicating the position of any variation of percentage of the three ingredients (cement, lime and sand) for each of the properties.

To determine the relative values of any number of different mixtures, the position of the mixture is marked on the proper tracing-cloth diagram and the location of that point noted by superposition of the tracing on each of the contour diagrams.

Aggregates for Road Concrete a Measure of Road Strength

On the assumption that the two main causes of deterioration of concrete in roads are the wearing action of traffic and the cracking of the concrete due to its lack of tensile strength, J. P. Nash, of the University of Texas, made tests on concrete of different aggregates in order to determine the resistance to abrasion and the tensile strength in large sections. The abrasive tests were made by measuring the loss on the inside of an annular ring subjected to the battering of the cast-iron cubes of an ordinary rattler. The tension tests were made on briquets of 25-sq.in. section shaped like the standard 1-in. briquet. Concretes of different types of aggregate and different mixtures were used.

The general conclusions are that uniformity of wear is obtained when the mortar and the coarse aggregate wear equally, and for this condition crushed limestone or limestone gravel had better be used. Coarse aggregate should be limited in size to about 1½ in.; but when a hard tough stone is employed, the size should be limited to about 1 in. and the cement content increased. There seems to be no difference in the tensile strength of concrete made of crushed stone or of gravel. The wearing quality of the stone is somewhat superior. It is questionable if a richer mix than 1:2:4 is economical with crushed limestone of the ordinary hardness. The use of more cement tends to contraction cracks that offset any gain in tensile strength. Crushed slag, when hard and uniform, should be satisfactory as a concrete-road aggregate.

High-Silica Portland Cement

In the construction of the Ebro dam, near Barcelona, Spain, lack of near-by commercial cement mills required the construction of a mill near the dam. The rock here proved to be so high in silica that several experts reported that it would be impossible to make cement of the material available. The construction managers, however, proceeded to construct a two-rotary, dry-process plant, electrically equipped throughout, with a nominal capacity of 1500 bbl. per day. The cement produced had about 26.45% of silica, as against 22%, the normal average of an American cement.

A description of the cement is given by A. W. K. Billings, of the Ebro Irrigation Power Co., Barcelona. He found that it set within the usual time, but hardened

very slowly, and that it was uniformly sound and under the autoclave test always gave satisfactory results. The strength at 1, 7 and 28 days was frequently less than that required by standard specifications, but at later periods the curve rose above the standard requirements. Concrete cut from the dam in cubes in some instances reached 6200 lb. per sq.in. in compression.

In the manufacture of the high-silica cement, the temperature required in the kiln is considerably higher than for average cement. More fuel is required and the cost of maintenance of the kiln lining is greater. The increased coal consumption amounts to about 6% of the weight of the cement. Mr. Billings concludes that for purely commercial competition with near-by mills such cement would be at a considerable disadvantage, as it would also be in ordinary reinforced-concrete work where quick hardening is necessary. For mass concrete work where high ultimate strength is useful, such cement might prove profitable.

What Effect Has Consistency on Concrete Strength?

L. N. Edwards, supervising engineer of bridges, Toronto, Can., reported a rather extensive series of tests investigating the effects of grading of sand and consistency of mix upon the strength of plain and reinforced concrete. The tests were made upon (1) cylinders in which twelve sands of predetermined gradings were used as fine aggregates; (2) cylinders and reinforced-concrete beams in the preparation of which five consistencies of mix were used; and (3) cylinders in which time of mixing was from ¼ to 2 min. The conclusions agree with those of later similar investigations.

In brief, they are that the common visual examination test of sand is unreliable, that the volumetric method of proportioning is impracticable and unscientific, that the value of a sand for concrete can be determined by testing concrete made from that sand, that the strength of concrete increases with the time of mixing at least up to 2 min., that excess water decreases strength, that there is no definite relation between the compressive strength of mortar cubes and of concrete produced from the same sand.

Two parts of Mr. Edwards' conclusions, in detail, are as follows:

"The excess water in an oversaturated concrete necessarily occupies space and thereby bulks up the mass. By reason of its high surface tension, it forms water globules which, although somewhat affected by the weight of the concrete, are nevertheless distributed throughout the mortar component and are accumulated underneath the particles of the sand and stone aggregates and the reinforcing steel. By evaporation, this excess water ultimately disappears, leaving a considerable volume of water voids and cavities which constitute an extremely important factor in the strength and reliability of the concrete.

"The critical failure of reinforced concrete depends upon the intensity of the bond existing between the concrete and the steel reinforcement. Concrete containing an excess of water not only develops less surface contact with the steel on account of the resulting increase in the volume of water voids and cavities; but in addition, the excessive laitance produced by the water tends to accumulate around the reinforcement, thus contributing materially to a decrease in strength. This condition becomes further aggravated by reason of the tendency of the laitance to become less resistant with age."

Void Theory of Concrete Mixtures Amplified To Include Costs

In a paper presented at the convention of the American Society for Testing Materials two years ago, J. A. Kitts laid down the principle that the best concrete mixture from the point of view both of strength and economy is one in which the voids in the sand approach being filled by the cement and the voids in the coarse aggregate by the mortar. Following up this theory, particularly in regard to economy, he has analyzed a number of reported tests, and has deduced certain conclusions, which he reported at this year's meeting of the society.

The main results for concrete may be stated as follows: For economical proportions the volume of cement should be equal to or greater than the volume of voids in the sand, but not to exceed a multiple of 1.5; and the volume of mortar should be equal to or greater than the volume of voids in the coarse aggregate, but not to exceed a multiple of 1.5. The economy factor expresses the relative efficiencies of concrete mixtures and may be determined by the equation

$$\text{Economy factor} = \frac{\text{Compressive strength} \times \text{yield}}{C_c + \frac{P_s}{P_c} C_s + \frac{P_r}{P_c} C_r}$$

where P_c, P_s, P_r equal volumetric proportions and C_c, C_s and C_r the costs in dollars per cubic yard of cement, sand and rock respectively. The yield is based on the volume of the coarse aggregate as unity.

Concrete Slabs Prove Stronger After Excess Water Is Rolled Out

The method used in Macon, Ga., of finishing concrete roads—that is, by rolling the fairly wet concrete with a light roller to force the excess water out—was tested in the laboratory of the Lewis Institute and reported by A. N. Johnson, of the Portland Cement Association. The concretes used were of the following consistency: Dry (finished with wood float in the ordinary way); wet (finished with wood float in the ordinary way); and wet (finished by means of a roller). The dry-consistency slabs were as stiff as could be easily handled, much different from those usually found in concrete-road work where conditions require a fairly wet mix. All slabs were made and tested in flexure.

Four slabs of wet consistency, finished by hand, had an average modulus of rupture of 308 lb. per sq.in. Four slabs finished with the roller had an average modulus of rupture of 369 lb. per sq.in., an increase of 20%. The slabs made of a stiff mixture—that is, of a medium consistency—give an average modulus of 340 lb. per sq.in.; that is, they are stronger than those of a wet consistency finished in the same manner, but the wet-consistency slabs finished with the roller are stronger than those of medium consistency, showing an in-

crease of nearly 10%. Mr. Johnson concludes that the tests show that by roller manipulation the supposedly necessary wet mixture may be made perfectly satisfactory for road use. The rate of application of load affects the compressive strength of the concrete under test.

Specific Gravity of Fine Aggregate Definitely Determined

Specifications for fine aggregate for concrete generally call for a determination of the specific gravity of the material. This is required to be the apparent specific gravity—that is, the specific gravity of the mass of the aggregate, including the air spaces or voids. Difficulty has been found in determining this, and A. S. Rea, testing engineer of the State Highway Department of Ohio, has recently devised a method which is successfully used by that department.

A sample of the aggregate is placed in a graduated cylinder and a small amount of kerosene poured over the grains, of sufficient quantity to saturate the grains and allow for a slight excess. The cylinder is vigorously shaken until all the grains appear to be coated with kerosene. A measured quantity of water is then introduced into the cylinder, and it is again shaken, the excess of kerosene being brought to the surface. The line of demarcation can be read between the two liquids. From the dry weight of the aggregate and the volume of the liquid displaced, the apparent specific gravity of the aggregate can be calculated. This method is based on the principle that the pores in the grains will be filled up with the kerosene, preventing any water entering there. The water measured will then be accurate.

Some New Testing Devices

By using a wedge-shaped test piece in a special air bath, J. A. Capp and F. A. Hull obtained, in addition to the melting point, several valuable indications of the changes in condition of the material throughout the temperature range below the melting point. They have found this method particularly interesting when examining materials that must be used under condition of stress.

The alternating torsion testing machine described last year by D. J. McAdam, Jr., has been improved by the insertion of a helical spring between the test specimen and the reciprocating arm. The spring automatically increases the angle of torsion of the test specimen as the specimen yields, thus keeping the torsional moment nearly constant until just before the specimen breaks.

At What Speed Should Concrete Tests Be Made?

In compression tests of concrete, the rate of application of load has an important influence on the strength. A series of tests made by D. A. Abrams of the Structural Materials Research Laboratory, Lewis Institute, Chicago, shows some results along this line. For rich mixtures (1:5 and 1:3) tested at the age of 28 days, the strength when loaded at 0.15 in. per min. was 14 to 20% higher than when loaded at 0.006 in. per min. When part of the load is applied at a fast speed and the remainder at a slow speed, the ultimate strength is not changed, even though as much as 88% of the total load be applied at the fast speed. Knowing the approximate strength of the specimen, it will greatly expedite the work of testing and involve no sacrifice in accuracy if we apply, say, 50 to 75% of the ultimate load at a fast speed before changing to slow speed. A machine speed that gives a shortening of the test piece of 0.01 to 0.02 in. per min. per ft. of length is recommended as a standard rate for compression tests of concrete.

Saybolt vs. Engler Viscosimeter

The usual methods of obtaining absolute viscosity by a translation of Saybolt and Engler figures through the equation of Ubbeholde are called into question by Winslow H. Herschel, who shows that, since the critical velocity of water through the short tube of these viscosimeters is greater than 800 times the kinematic viscosity divided by the diameter of the tube, an additional correction factor should be applied. He intimates that there is a need for scientific purposes of a self-contained, portable and durable long-tube viscosimeter by means of which absolute viscosity may be measured directly.

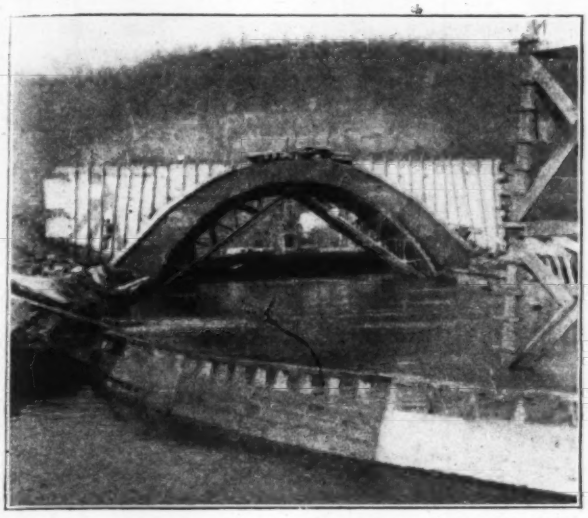
The use of the Engler viscosimeter for the purposes of determining the consistency of heavy road oils is questioned by Prévost Hubbard and F. P. Pritchard, who have found that bitumens having a penetration too high to be determined on the penetrometer, and a viscosity too great to be determined on the viscosimeter at normal temperatures, may at the necessary abnormal temperatures show an identity of consistency which will disappear when more normal temperatures are employed. To fill the gap between the penetrometer and the viscosimeter, they have designed a new form of consistency tester. It is an aluminum plunger to the top of which is attached an aluminum retarding disk. The settling of this through the bitumen contained in a specially designed water bath gives a very satisfactory measure of the consistency of the bitumen in service.

Finding the Yield Point in Steel by a Semi-Autographic Method

In the testing laboratory at the University of Illinois, H. F. Moore has been successfully determining the proportional limit of material with a testing rig that is semi-autographic in its nature and is applicable to rapid speed of the machine. It has been used in two forms, one of which takes two men to operate, while the other allows the whole testing and recording of operations to be carried on by one man. Essentially, it consists of a cylindrical record that is moved circumferentially by hand control and vertically travels automatically proportionately to the travel of the poise of the machine. The operator controls the circumferential motion by a ratchet wheel, moved at regular intervals as noted on an extensometer attached to the testing piece. The resulting record is a stepped curve on which the horizontal steps represent successive fixed elongations and the vertical steps definite loads.

Covered Concrete Channel for Creek at Steel Plant

Built with Dragline and Floating Mixer Plants—Concrete Delivered by Rail and Chute—Forms Rolled Around Curve



MAN SHOWS SIZE OF HUGE CULVERT

IN BUILDING about 1000 ft. of covered creek channel, in three sections, to divert Peters Creek where it flows into the Monongahela River at the north end of the Clairton (Penn.) works of the Carnegie Steel Co., the contractor placed the concrete with floating mixing plants in the river, partly by direct spouting and partly by carrying it to the forms in industrial cars. The work was handled with one dragline, two whirler derricks, a floating dredge and a piledriver for the excavation and foundation work. One concrete plant placed the two sections farthest from the river and then assisted a second plant to finish the river section. The first mixer boat, equipped with a short steel tower, delivered concrete to an industrial railroad, which distributed it to be placed by the whirlers. The second plant, which completed the outer end of the river section, was operated by spouting direct to place.

The large, heavy arch sections were constructed with inside forms of the contractor's design and manufacture, which were moved around curves as easily as on a tangent.

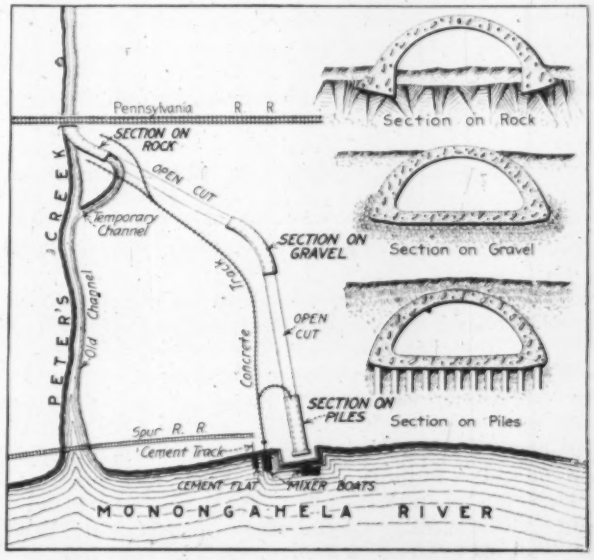
Creek Under Site for Coke Plant

The plant, between the Pennsylvania R.R. and the river, is situated on an alluvial deposit that varies from 20 to 50 ft. in depth from the surface to rock. Across the northern end of the site, where large extensions to the coke-making capacity of the plant are to be located, runs Peters Creek. As this entire area is to be filled to a higher level, it was decided to construct a covered channel for the creek. In order to reduce the cost of the work, the new channel was relocated. Since sections of the new creek tunnel will be subjected to heavy loads from large structures, two gaps were left in the tunnel where future buildings will be erected over the new line of the creek. These gaps will remain as open channels until the slag fill has been carried to full height on each side of them, after which pile or other foundations for the permanent structures can be constructed and the covered channel and fill completed.

The old creek channel ran almost at right angles to the axis of the property, from a double-barreled stone culvert beneath the Pennsylvania R.R. line to the river. To get away from this channel and make construction easier, the new line of the creek curves away from the culvert sharply, pursues a straight course until the first open channel section is passed, curves back toward the river in the second concrete section, passes through a second open space, and reaches the river through a third covered channel, supported on piles.

Construction of Bypass Avoided

The flow of the creek was no disturbed by the construction of the first section, as it has no floor or invert. The arch is supported on side walls, which are carried down to rock 10 or 12 ft. below the creek surface. These walls on each side of the arch were constructed to a level above the spring line in four sections in steel cofferdams. One dam would be driven, excavated and concreted at a time, permitting the creek to take its course around the outside of the sheeting. At the completion of this operation the creek was flowing between the concrete side walls to the downstream end of the first section, where it was thrown back into the old channel through a temporary ditch. When this section of the new open channel is dredged, part of the excavation will be used to dam this ditch. This portion of the work was handled by setting up a large stiff-leg derrick on each side of the tunnel. After the section of the arch next to the railroad culvert had been placed, it would have been necessary to move the derricks in order to complete the second half of the arch away from the tracks. This was not done, however. The dragline, having gone as far as possible with the excavation of the open channel below, was rolled forward between the tun-



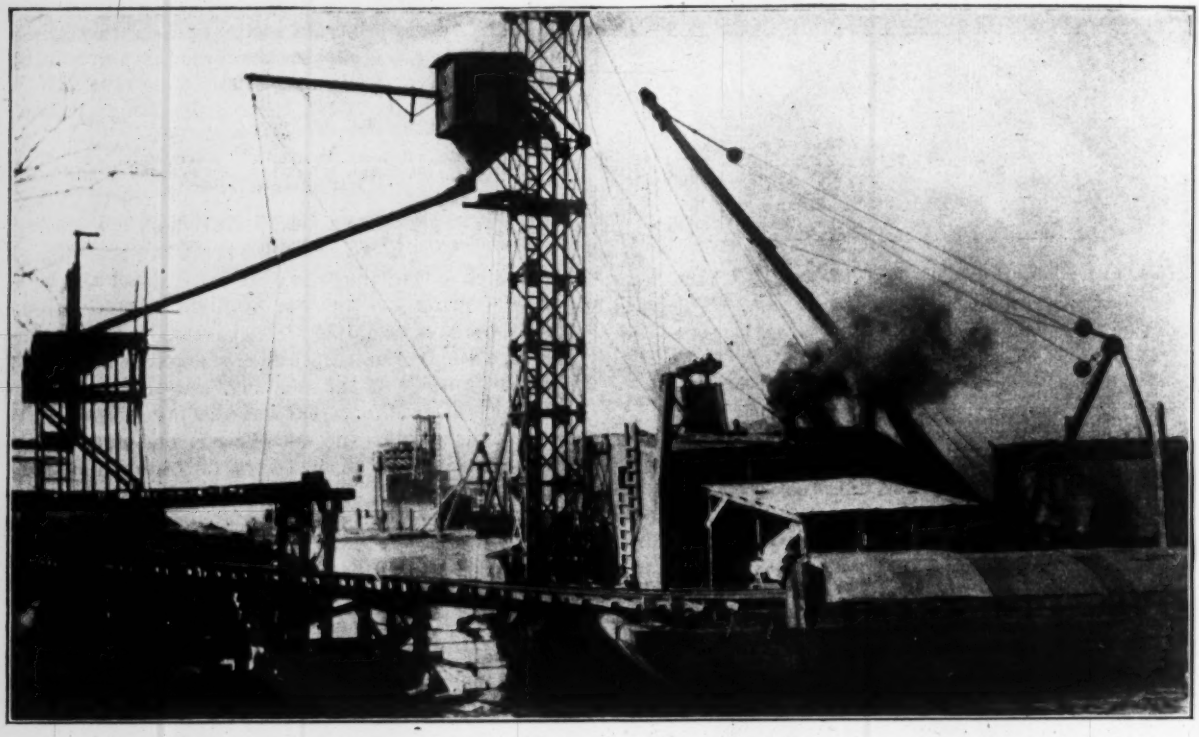
PLAN OF DIVERSION SHOWN IN SKETCH

nel and the railroad tracks and used to complete the second portion of the arch, which it accomplished in two moves.

The inside forms, carried by three-hinged arch ribs, were moved on rollers on stringers supported by piles or posts just inside these side walls. The forms were raised on wooden wedges when in place, and were lowered several inches to clear in moving. As the arch ribs were not connected to each other except by the lagging, they could readily be set so as to pass around a curve. The same lagging could be used for both the curved and the straight sections. The outside forms were in slabs, secured to the inside forms with tie-rods to resist the pressure of the concrete. Universal form clamps were used, making it possible to get along with all rods of one length, the thickness of the arch varying considerably.

The excavation for the new channel was begun last fall, at the same time the coffer-dams for the side walls on the section next to the railroad were begun and the piledriving for the river section started. The middle section, however, being supported by a concrete invert resting on gravel, was naturally ready for concrete some time in advance of the more difficult sections. It was accordingly completed and backfilled before the section next to the railroad was done or the work of concreting the river section had started. Similarly, the river section, which required the driving of 3700 piles with a floating rig and the subsequent closing and pumping of a box coffer-dam in the Monongahela River, took longer to prepare for concrete than the section next to the railroad. Consequently, all the other concrete work had been finished by the time the river section was ready for pouring the invert.

The work extended for about a third of a mile. It was cheapest to receive gravel and sand by water and to distribute concrete by a narrow-gage line at ground level. Accordingly, a floating concrete plant with a short steel tower, a 1-yd. mixer and a whirler derrick mounted on the rear end was moored to the bank just upstream from the mouth of the new channel, and a section of chute was rigged to a hopper over the end of the narrow-gage line. Two dinkeys, each pushing a platform car carrying four 1-yd. concrete buckets, were operated on this road. The buckets were picked up by the derricks, or whirlers, and dumped directly into the form, except for the middle section. Here, during the winter, heavy rains had caused the cut to cave until it was necessary to locate the whirler so far from the forms that it could reach only to the center of the channel. To pour the invert and side walls in this section, a tower surmounted by hoppers into which the bucket could be dumped was moved along the center line of the work by the whirler and used to spout concrete to the far side of the excavation.



CEMENT RECEIVED BY RAIL, GRAVEL BY WATER, AT FLOATING CONCRETE PLANT ADAPTED TO "LAND" JOB WITH ECONOMY

River Plant Solves Supply of Concrete Materials

Sand and gravel, dredged from the river, were unloaded directly into bins on the mixer boat. Cement was received by rail, and run on a spur track to the bank at the mixing plant. Here it was unloaded to one of a pair of platform cars running down an inclined bridge to the deck of a scow alongside the mixer boat. One of these cars was fastened to each end of a wire rope passing around a sheave at the head of the bridge, and the loaded car pulled the empty car up. From the small scow the bags were shot down a plank slide to the deck of the mixer boat. The cement was used at this level,

the mixer having a power loader and being set directly on the deck. This arrangement also permitted the construction of large sand and gravel bins without making the boat topheavy. The tower bucket descended into a pocket below the deck in front of the mixer.

Two Plants To Finish Last Section

The second mixing plant, brought up to complete the outer end of the last, or river, section, is provided with a much higher tower than the first, but mounts no derrick, being supplied by a derrick boat. Moored outside the

CONCRETE DISTRIBUTED FROM TOWER

box coffer around the end of the section, it can spout directly all the concrete for the 270 ft. of the tunnel nearest the river. The concrete in the rear part of this section will be mixed by the other plant, transported by the dinkeys and placed by one of the whirlers.

Caving Banks Require Handling of Extra Material

The dragline machine excavated the middle concrete section and the better part of the open channel section farthest from the river, working toward the railroad, which brought it in position to finish the concrete work at this point, as noted above. It then completed the open channel section. One of the whirlers concreted and backfilled the central concrete section, made the cut for the second open channel section, helped a floating grab-bucket dredge with the river section and finally was carried down inside the cut for this section on top of the piles to clean out material that slid in from the banks. This section required the deepest cut on the work, and the whirler, working the floor of it, could not reach out to dump material. On this account a central hopper and a small inclined hoist up one side of the cut were installed to hoist out and dispose of the dirt in these slides. The hopper was located where the machine could reach most of the slides to be removed without getting out of its range. The other whirler did most of the unloading of piling and plant and placed some of the concrete in the river section.

The dragline was designed by the contractor and is similar to the whirlers used by the same firm. They were described on p. 506 of *Engineering News* for Sept. 9, 1915. However, the machine installed at Clairton is much heavier. It handles a 1½-yd. bucket.

The work described, which has required about 25,000 yd. of concrete, is being completed for the Carnegie Steel Co. by the Dravo Contracting Co. under the direction of J. J. Nolan, secretary, with W. H. Horton in charge as superintendent. For the Carnegie Steel Co. the construction is being supervised by C. V. Wykoff, chief field engineer of the Clairton works.

Meters Cut Water Waste and Help Home Gardening

By Walter P. Schwabe
President, Thompsonville Water Co., Thompsonville, Conn.

The introduction of meters has enabled the Thompsonville Water Co., of Thompsonville, Conn., to reduce its water consumption materially and to encourage home gardening by offering special rates for water.

The property of the company was taken over by its present owners about three years ago. At that time there was considerable complaint on account of inadequacy of pressure and also a shortage of water. Consumers were forbidden to use hose for sprinkling, and the town was obliged to discontinue the sprinkling of streets. The output at the time sometimes ran as high as a million gallons a day.

On taking over the property the present owners made improvements; that is, installed a 500,000-gal. elevated tank, raised the pressure over the entire system 30 lb., put in larger feed mains and immediately metered the entire system. About 1800 meters are now in use. The maximum daily output has been reduced to between five and six hundred thousand gallons.

We are therefore enabled to encourage the use of water in connection with the home-gardening movement and to that end are advertising in the local paper that water for gardening will be supplied at 20c. per 1000 gallons.

Deepest American Drill Hole

A diamond-drill hole in Sussex County, New Jersey, 4920 ft. deep, has recently been completed by the contract drilling forces of the Sullivan Machinery Co. A 2-in. diameter core was removed to a depth of 1600 ft., beyond which tols removing a 1⅛ in. core were used to the completion of the hole. When the depth of 4900 ft. was reached, the long line of rods required for drilling weighed 13 tons, and it took 8 hours' steady work for hoisting them out, replacing them and resuming drilling. It is said that the hole showed no deviation from the perpendicular. It required 20 months to complete the hole, which is 1700 ft. deeper than the deepest previous hole of which there is any record in North America. Only three or four diamond-drill holes have been put down in this country, it is said, exceeding 3000 ft. in depth.

Diagrams Facilitate Design of Concrete Retaining Walls

Two Standard Types of Wall Considered, One Without Surcharge and the Other with Surcharge of Cooper's E-55 Live-Loading

BY SOMERS H. SMITH
Structural Designer, Chicago, Milwaukee & St. Paul Railway, Chicago, Ill.

IN THE *Engineering Record* of Nov. 4, 1916, p. 564, there appeared an article by T. A. Smith giving formulas for width of base of gravity retaining walls to eliminate tedious cut-and-try methods of solution. The writer has been using diagrams in solving these problems for some time and believes that for railroad work, municipal work, etc., where the assumptions and types of wall are more or less standardized, the diagrams are simpler and more convenient than formulas. For the purpose of illustration two cases will be considered—(1) that of a gravity wall without subcharge, and (2) that of a gravity wall with railroad surcharge of Cooper's E-55 loading, with center line of track 8 ft. 6 in. from the face of the coping.

GRAVITY WALL WITHOUT SURCHARGE

1. A gravity retaining wall of the type shown in Fig. 1, which is safe against overturning, will also be safe against sliding and crushing the masonry, and with a

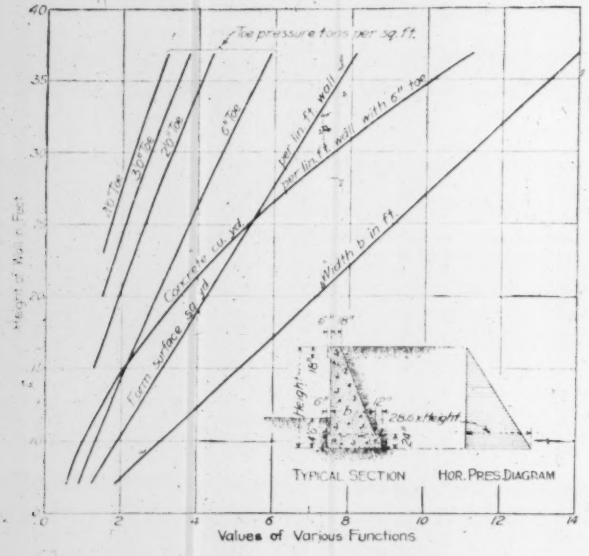


FIG. 1. DIMENSIONS AND QUANTITIES—WALLS WITHOUT SURCHARGE

suitable toe may be built upon any ordinary foundation. We may then assume a minimum factor of safety against overturning and find the widths of the base for various heights. Assuming that the slope of repose of the filling is 1½ to 1, the horizontal pressure on a vertical plane is, according to Rankine, 0.286 of the vertical pressure. Earth has been taken at 100 lb. per cu.ft., and concrete at 150 lb. per cubic foot.

The diagram, Fig. 1, gives the width of the base of the neatwork for a factor of safety against overturning of exactly 2. Using a minimum footing projection of 6 in. at the toe and 1 ft. at the heel, the entire wall always has a factor greater than 2. The maximum compressive stress in the concrete is 90 lb. per sq.in., and the wall will be on the verge of sliding when the coefficient of friction is about 0.3.

Soil pressures for various assumed lengths of toe are also given in the diagram, as well as the quantities per linear foot of wall for estimating purposes.

GRAVITY WALL WITH SURCHARGE

2. The dead-load for the case of a surcharge wall is considered the same as in case 1. The live-load has been taken as 11,000 lb. per lin.ft. of track, distributed from

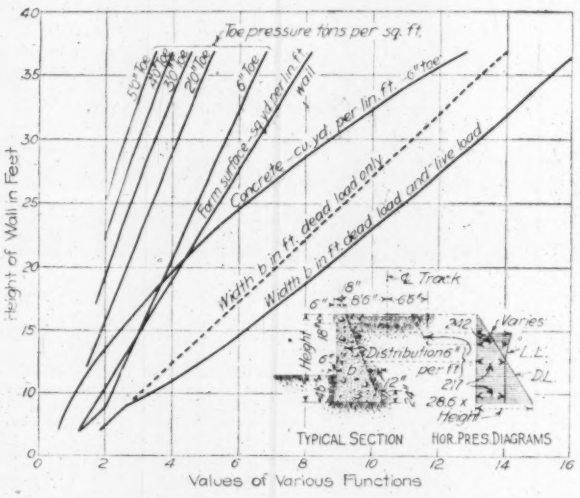


FIG. 2. DIMENSIONS AND QUANTITIES—WALLS WITH SURCHARGE

the base of rail and end of tie as shown in Fig. 2, the limits of the distribution being the face of the wall and a line 6 ft. 6 in. from the center line of the track midway between tracks, assuming a second track 13 ft. from the first. The ratio of horizontal to vertical live-load pressure has been taken the same as for the dead-load. The portion of the live-load pressure uniformly distributed over the width b has been assumed as adding to the weight and stability of the neatwork, while for the entire wall the width $b + 1$ has been used. No distribution has been considered beyond the plane of the face of the wall, no matter what the length of the toe might be.

The horizontal-pressure diagrams are shown in Fig. 2, and the widths of the base of the neatwork for dead-load and live-load are plotted on the diagram, as are also the values for dead-load only. The factor of safety against overturning for the neatwork is exactly 2. The maximum compression in the concrete is 103 lb. per sq.in., and the wall will be on the verge of sliding when the coefficient of friction is about 0.3, as before. The maximum soil pressures under the toe for various lengths of toe, and the quantities per linear foot of wall, are also given in the diagram, Fig. 2.

The maximum case for railroad loading would occur with a locomotive on a track 6 ft. 6 in. from the face of the coping, assuming this to be the minimum allowable clearance, while the minimum case would occur when there was no live-load. For heights less than

about 9 ft. the live-load does not increase the width of the base, merely adding to the crushing stress and the soil pressure. The limiting values for the height of wall have been selected so as to make the diagram general for all heights likely to be encountered. It is not intended, however, to indicate that gravity walls of the extreme heights shown could be economically built. For estimating purposes, the quantities for the higher walls would be on the safe side.

With a set of these diagrams for the various types of wall commonly used, a design can be made in a very short time; and where there is much of this class of work, the time saved amply repays for the time spent in preparing the diagrams.

Do Water Filters Make Watershed Ownership Unnecessary?

On This Question Hinges a Water-Rate Case in California Involving a Valuation of $4,000,000

THE Peoples Water Co. has been recently reorganized into the East Bay Water Co., which institution supplies the towns on the east side of San Francisco Bay from Richmond to San Leandro, including Oakland, Alameda and Berkeley, Calif. The water partly comes from deep wells at Alvarado and Fitchburg. About 60,000,000 gal. daily at present are derived from a large storage reservoir on San Leandro Creek, known as Lake Chabot, above which there are 42 square miles of drainage area. The San Pablo dam is now being built on San Pablo Creek. It has 32 square miles of tributary watershed. The East Bay Water Co. owns 50% of these drainage areas. Certain other small drainage basins are held in reserve for future development.

In a hearing before the California Railroad Commission for the purpose of fixing rates, it was recommended by the hydraulic engineers of the commission and by the representatives of Oakland and Berkeley that about $4,000,000 worth of these watershed lands should be excluded from the portion of the property that was deemed used and useful. The contention of the water company was that these lands were necessary for the prevention of the pollution of the water at its source, notwithstanding the fact that the water was held in long storage, filtered and chlorinated.

What Other Cities Are Doing

Very extensive inquiries were made by the company throughout the cities of the United States that obtained their water from surface supplies; and while a number, such as New Orleans, Washington and Philadelphia, are practically compelled to obtain their supplies from large rivers the watersheds of which they cannot control and where they are of necessity compelled to rely on filtration, the great majority of the towns, where it is feasible, are seeking what they call "upland sources," the drainage basins of which they are endeavoring to acquire and rigidly protect. Many of these towns, such as Providence, R. I., are buying watershed lands, notwithstanding their plans call for filtration and long storage.

All of the towns did not answer the inquiry. Answers were obtained from 75 cities outside of California. Of these 61 owned drainage-basin lands ranging from a few per cent. to the total area; 5 do not have storage, but divert their water from large rivers or lakes; 46 consider it important to own drainage-basin lands, and 24 towns were indefinite as to their policy. In California, out of some 50 replies received from the circular letter, all but 3 considered watershed lands important to supplement the protection of the water-supply. Local conditions affected somewhat these places, so as to afford unusual circumstances.

Practice in Western America

It is distinctly the practice of Western America, where possible, to obtain water-supplies from timbered or brush-covered hill or mountain country. The City of Portland, both by purchase and by act of Congress, has acquired practically all the watershed lands in Bull Run Creek, located in a national reserve that furnishes its water-supply. It has obtained an act of Congress making it a misdemeanor punishable by a fine not to exceed $500 even to trespass on this watershed.

The Marin Municipal Water District, north of San Francisco Bay, which is just building its system, has acquired by purchase all the lands, amounting to 11,500 acres tributary to its water-supply.

The case of the City of Santa Barbara is typical. A forest reserve has been created to protect the headwaters of the Santa Ynez River above the diversion point, and in addition the city has purchased some 4000 acres of private lands to complete the protection of its watersheds.

The question of the retention of the watershed land of the East Bay Water Co. has now been submitted to the Railroad Commission, and the decision is awaited with great interest.

The engineers for the company were George Wilhelm, engineer and manager of the company, F. C. Herrmann, George C. Whipple, J. B. Lippincott and William Mulholland. The Railroad Commission was represented by R. W. Hawley. J. H. Dockweiler represented the City of Oakland. The State Board of Health was represented by its chief engineer, C. G. Gillespie, who took the position that these lands were not essential for the protection of the water-supply, and by the president, who subsequently testified that the board would protest against their disposal if it was attempted.

Filtration Costs at Washington

The water-purification plant of Washington, D. C., was operated at a cost of $6.26 per 1,000,000 gal. of water filtered for the year ending June 30, 1916. The average daily consumption was 51,910,000 gal., or a per capita daily consumption of 145 gal. The average bacterial count of the raw water was 5540 per c.c. and of the treated water 15 per c.c. The turbidity was reduced from 238 in the raw water to 0 in the filtered water. Detailed results for a series of years both as regards labor and material cost and various physical operations of the plant, as well as total bacteria and B. coli removed, are given in a small pamphlet report on the maintenance and repair of the Washington aqueduct and filtration plant by C. A. F. Flagler, Lieutenant-Colonel, Corps of Engineers, U. S. A., in charge. E. D. Hardy is superintendent of the filtration plant.

Dallas Builds Imhoff Sewage Works Fed by Concrete Pressure Line

Little Leakage Through Expansion Joints Every Length—Carry Groundwater at Disposal Plant in Rock Channels Under Finished Tank Bottoms—Each Steel Form Section Used Twelve Times

By RICHARD GOULD
Resident Engineer for James H. Fuertes, Consulting Engineer, New York City

A CONCRETE pressure line nearly 3 miles long, with exceptionally tight joints, carries the sewage of Dallas, Tex., from the pumping station to the sewage-disposal plant of constant-velocity grit chamber and Imhoff tanks. The abundant supply of groundwater in the gravel over the rock at the plant site was drained to the center under the concrete floor, the holes for pump suctions being grouted when the work was completed. The plant was under construction for two years prior to being put into operation in January. It serves 135,000 people, including 11,000 residents outside the city limits.

The Trinity River flows through the city. Formerly, all the sewage of Dallas was discharged directly into it through seven outlets. The river also receives the sewage from Fort Worth and other smaller cities. Its flow is ordinarily sluggish, and sometimes in dry weather there is little dilution of the sewage. Because of this offensive condition, steps were taken to remove the sewage from the river some time before the passage of the present stream-pollution act, and the following plan was carried out:

Intercepting sewers, 15 to 51 in. in diameter, were constructed in the lowlands adjoining the river, to intercept the flow in the existing trunk sewers and to carry it to a pumping station centrally located at Cadiz St. on the east bank of the river. The sewers up to 24 in. in diameter are of vitrified and cast-iron pipe, and aggregate 6¼ miles in length. The larger sewers, comprising 7706 ft., are of concrete pipe. The intercepting sewers in Oak Cliff, which is the portion of Dallas lying west of the river, lead to a point opposite the Cadiz St. pumping station, the sewage being siphoned under the river through four lines of cast-iron pipe. The sewage from the entire city, with the exception of that from a small area at the extreme southern portion, flows to the Cadiz St. pumping station by gravity. Thence it is pumped a distance of 14,744 ft. down the river to the disposal works. The static lift is 42 ft.

Automatic Bypass on Pump Suctions

The three pumping units consist of Worthington centrifugal pumps, each connected by rope drive to a Fleming-Harrisburg noncondensing engine. The rated capacities are 4,500,000 gal., 7,000,000 gal. and 11,000,000 gal. daily respectively. Steam at 150 lb. is supplied from two 150-hp. Stirling boilers.

In advance of the pumps are two bar screens of 1-in. opening, each fitted with an apron at its base. For cleaning, they are hoisted to a screen room, where a Coffin hydraulic sewage press is provided for pressing the screenings. The resulting cake is burned under the boilers.

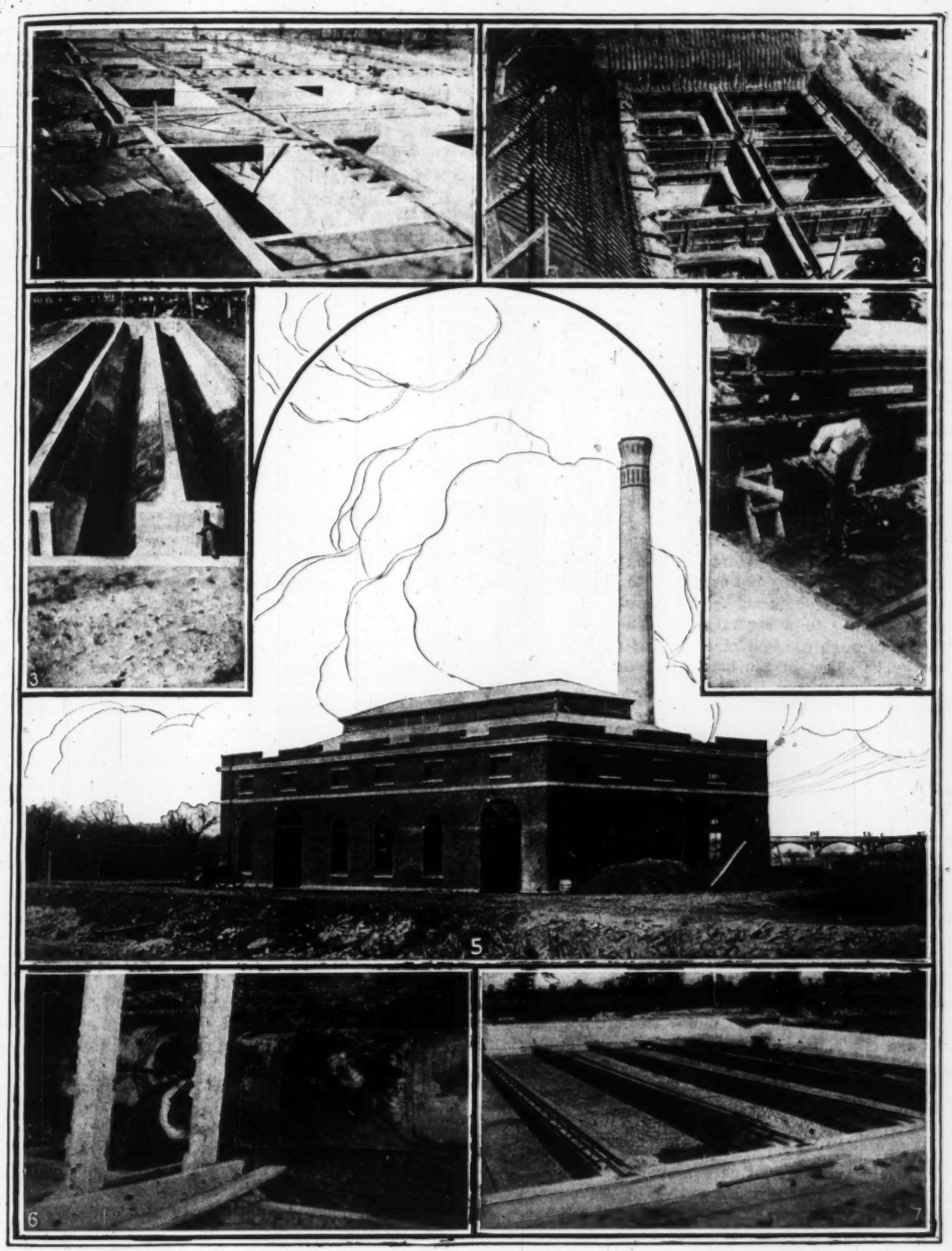
No storage is provided in the suction well, but the suction of the pumps is kept sealed by means of a bypass operated automatically. This is accomplished by running a 12-in. line closed by a hydraulic valve from the force main to the bottom of the suction well. The valve is actuated by city water pressure controlled by a fourway valve connected to a float in the suction well. A compensating motion connected with the stem of the hydraulic valve insures smooth opening and closing. An indicator in the engine room shows the level of the sewage in the suction well, so that the bypass is only brought into action when the warning of the indicator is neglected.

Each of the pumping units is provided with a Lockett rate-of-flow indicator. This instrument is connected to two points in a cast-iron increaser. The difference of static head between the points is shown by water columns in two adjacent glass tubes. A calibrated scale placed between the tops of the two water columns indicates the discharge of the pump.

Force Main Tight

The 36-in. force main from the pumping station to the disposal works passes under the Trinity River, being laid in the same trench with the Oak Cliff sewer siphons. The first 476 ft. of the line is of cast iron. From the west bank of the river the main is of reinforced concrete, 14,268 ft. in length, subjected to a working head up to 60 ft. The pipe, which was manufactured and laid by the Lock Joint Pipe Co., is 4 in. thick, of 1:1½:2½ concrete, made in sections 8 ft. long. The reinforcement varies according to the pressure to which it is subjected, ½-in. bars 4 in. c. to c. being used for the maximum pressure and No. 31 wire mesh for the minimum pressure. All joints are expansion joints, and each is made water-tight by a continuous copper band molded into the spigot end of the pipe and grouted to the joint reinforcement projecting from the hub end of the adjoining pipe, but the spigot was painted to prevent adhesion of the grout. Contraction occurs at this point, and motion is taken up in a crimp provided in the copper band. A recess 4 in. wide and $\frac{3}{16}$ in. deep was made on the inside of the pipe at the contraction joint. This recess was plastered full with neat cement reground to pass a 200-mesh sieve.

A test for leakage, made with filtered water up to the maximum pumping head, showed a total leakage for the concrete pipe of 17,700 gal. per day, or 6550 gal. per day per mile. The engineers attribute this low leakage to the great care by the contractor.



SEWAGE PLANT AT DALLAS, TEX., WHICH WAS PUT IN OPERATION LAST JANUARY, AFTER A TWO-YEAR CONSTRUCTION PERIOD

Fig. 1—Six rows of two Imhoff tanks each
Fig. 2—Steel forms still on brace walls in sludge compartments
Fig. 3—Grit chambers have gravel bottom for easy cleaning
Fig. 4—Dump-cars run on distributing channels
Fig. 5—Pumps raise sewage here 42 ft.
Fig. 6—Setting concrete pipe
Fig. 7—Sludge dries quickly

The disposal works built at this time consist of a grit chamber, 12 Imhoff tanks, a sludge-drying bed and a discharge conduit. The grit chamber is 100 ft. long and is divided into three parallel sections. Its cross-section is such that, combined with the hydraulics of the channel leading to the tanks, the velocity of the sewage in the chamber varies but slightly, despite a considerable variation in the sewage flow.

The channels leading to the Imhoff tanks were designed for a maximum flow of 22,000,000 gal. daily, and it was expected that the present average sewage flow would be about 11,000,000 gal. daily. During the past year, however, the city water-supply has been completely metered and the water consumption thereby reduced 50%. This has affected the sewage flow, so that only 5,500,000 gal. daily reaches the disposal works.

Tanks' One-Way Flow

The Imhoff tanks are of the rectangular horizontal-flow type and have a combined capacity in the settling chamber of 1,312,000 gal. and a sludge-storage capacity of 440,000 gal. The settling chamber of each tank is 45 x 33 ft. in plan, and the sludge chamber is 29 x 19 ft. The tanks are 33 ft. deep. The sewage is divided into 12 parts, each part flowing through one tank. There is but one sludge compartment to each tank, and therefore no provision is made for reversing the sewage flow. Devices for agitating the sewage with fresh water are provided. Sludge is to be withdrawn through 8-in. pipes leading to a central open sludge channel and thence through a 12-in. pipe by gravity to the sludge bed. The slopes of the bottoms of the sedimentation chambers are 1.36 on 1. The flattest slope in the sludge chamber is 1 on 2.25.

The sludge bed is 141 x 145 ft. in plan. It has 14 in. of graded sand and gravel underdrained by 3-in. vitrified pipe laid with open joints 4 ft. c. to c. Sludge is distributed over the bed through seven concrete channels, each carrying a track on which run small dump-cars used to remove the dried sludge.

Clarified sewage from the tanks unites at a central point and passes over a weir into the discharge conduit and thence to the river. A continuous automatic record of the sewage flow is kept. The discharge conduit consists of 300 ft. of 24-in. pipe and 2042 ft. of 36 x 48-in. monolithic concrete sewer.

The complete plans call also for six acres of sprinkling filter followed by secondary settling tanks of the Imhoff type, but funds for this work were not available, as the city's bond limit (at the time of issuing the sewage-disposal bonds) limited the amount of the issue. The plant as constructed is built with provision made for the addition of the final treatment.

Lead Groundwater Into Cofferdam

Due to the material encountered on the site, there were several interesting features in the construction of the Imhoff tank. The bottoms of the tanks were sunk about 3 ft. into rock, over which was from 3 to 4 ft. of gravel grading off to a mixture of fine sand and clay. An abundant supply of groundwater normally stood 8 to 10 ft. above the rock. The entire site of the tanks was excavated with wheel scrapers about 17 ft. above the rock. The excavation for the 12 sludge wells, each 21 ft. 8 in. by 31 ft. 8 in., outside dimensions, was done inside of solid sheeting by means of a movable derrick using ¾-yd. buckets. Groundwater was handled by means of three pulsometers supplied by a single boiler. One of these was operated continuously in a well outside the limits of the tanks, in an effort to lower the groundwater somewhat. The other two were operated nearly continuously in the various tanks as was necessary. When excavated to the subgrade of the tanks, channels were cut into the rock entirely around the foot of the sheeting and to the center of each tank, in order to collect the water at one point. These channels were covered, and a concrete tank bottom was poured. A hole was left in the center of the concrete bottom to receive the suction of a pulsometer, which was kept in operation until the concrete was carried above groundwater level. When the concrete was sufficiently hardened, the pulsometer was removed and the groundwater allowed to seek its level. The hole in the bottom was then carefully packed full of neat cement. In only one of the 12 tanks was it necessary to try a second time in order to secure a tight plug.

Forms Used Twelve Times

Each section of the Blaw forms was used 12 times with the exception of one section where a duplicate form was necessary to expedite the work. Forming was shifted from one tank to another by means of blocks and overhead cables. Concrete was mixed in a ¾-yd. Smith mixer and was distributed over the work by means of an 80-ft. tower and chutes.

The Roach, Manigan Paving Co., of Fort Worth, had the contract for the pumping station, the cast-iron portion of the force main and part of the intercepting system; the General Construction Co., of Fort Worth, also had part of this system. The Lock Joint Pipe Co. laid the concrete portion of the force main as subcontractor to Bailey, Reeder & Co., of Mobile, who built the disposal plant and discharge conduit. The mechanical equipment of the pumping station was supplied by A. M. Lockett & Co., of New Orleans.

Costs of the various structures are as follows: Intercepting sewer, $217,303; pumping station, $93,962; force main, $95,865; disposal works, $96,245; discharge conduit, $13,109; land and right-of-way, $16,831; bond expenses, $1298; engineering, etc., $36,962; total, $571,575. Some detailed costs of the disposal plant are as follows: Imhoff tanks, $68,647; sludge bed, $17,957; grit chamber, $2030; influent channel, $547; water-supply and buildings, $4435; miscellaneous, $2629.

James H. Fuertes, of New York City, was the consulting engineer and drew up the plans and specifications. The works were constructed under the supervision of Hal Moseley, city engineer.

Tunnel Brickwork in Service After Sixty Years

Of four tunnels in the Blue Ridge Mountains on the Chesapeake & Ohio Ry., constructed between 1850 and 1858, three are lined with brick to horseshoe outline. As recently described by J. P. Nelson in a monograph on these tunnels, the brick arch is just as originally constructed. The total length of lining is about 2700 feet.

Reconstruction Executed Safely of Complicated Elevated Railway

Replace Three-Track Structure to New Grade and Track Alignment—Work Done One Span at a Time

By George D. Fried
New York City

A SPECIALLY difficult section of the rebuilding of the Broadway (Brooklyn) elevated railway to convert it to three tracks was encountered at a point near East New York station, where the new bents came intermediate to the old bents, and in addition the new structure was higher than the old by amounts of 2½ to 7 ft. The old tracks on the entire Broadway line are spaced too close to permit of inserting the third track between them without spreading. These several complications required a most carefully planned system of procedure to do the work systematically and without danger—traffic having to be maintained both on the elevated railway and on the street surface throughout the entire work.

The difference in track alignment and in bent location is shown by the plan. The difference in elevation, not there indicated, was taken care of as the first step by jacking the old structure in successive stages of from 3 to 6 in. at each bent, giving a maximum grade during the operation of less than 2%, until the whole section was raised to the new elevation.

The jacking was done by lifting the column-and-cross-girder bents with the specially designed jacking wagon illustrated in *Engineering News-Record*, Apr. 26, 1917, p. 221. To jack a bent, two wagons were used, one at either end of the cross-girder, the 14 x 14 jacking post coming in the position indicated in the drawing; after blocking the post up to the cross-girder and blocking the trucks up from the street to free the wheels, the entire bent was easily raised. The column shoes as they lifted from the masonry footing were wedged up, to keep all live-load off the jacks. Neither jacking nor releasing the jacks was ever attempted under trains, so that working conditions were always kept as safe as possible.

This work was done with Norton 100-ton self-releasing screw jacks. The load of 5 tons necessary to release was obtained by raising the structure at each point about 1 in. higher than the desired amount.

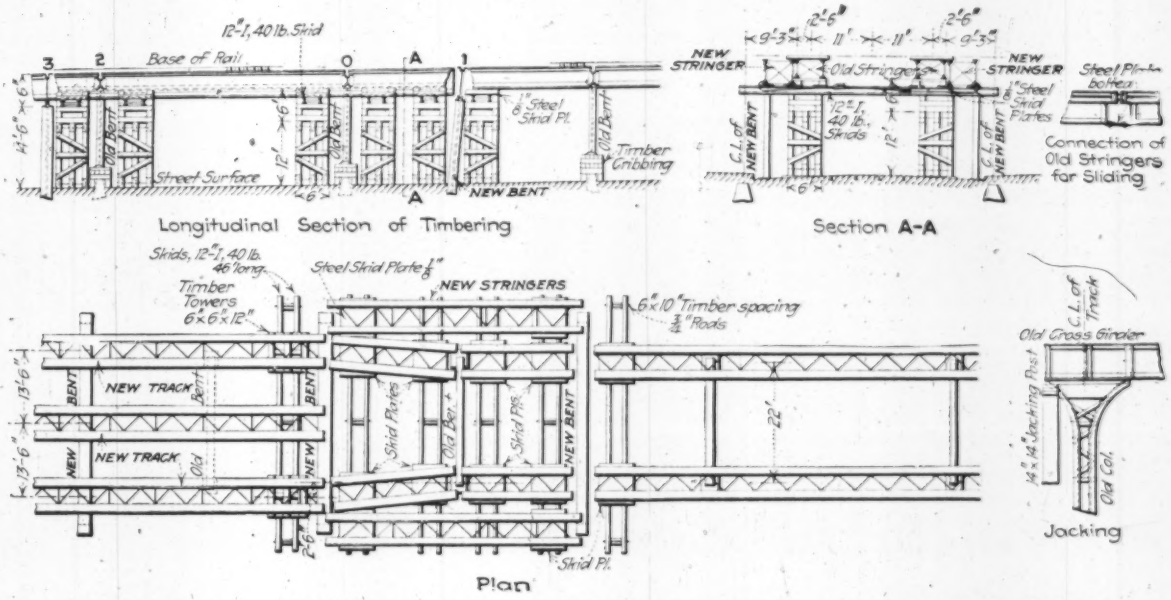
Old Stringers Cut To Allow Setting the New Bents

Timber towers 12 ft. high were built under the old stringers on either side of the old bents. These towers were 6 ft. square, built of 12 x 12's with 3 x 12 diagonals. A 6-ft. clearance from top of tower to bottom of stringer allowed for placing blocking and a transverse skid consisting of two 12-in. 40-lb. I-beams 46 ft. long, spaced 3 ft. apart by wooden spreader blocks. A ½-in. steel skid plate set on top of this skid, well greased, made ready for sliding the stringers over as was necessary at the later stages of procedure.

To make place for the new bents, it was necessary to cut through the old stringers. This was done by burning between bents. The new columns and cross-girder were raised, bolted up, and the bent tipped about 18 in. away from its true position to insure clearance for the new stringers during the sliding operation.

The new stringers, whose final position overlaps that of the old stringers, were set outside of the old stringers but close up to them, as indicated in the cross-section. The lateral bracing of the new stringers was completely riveted so as to make the span ready for moving and for taking traffic immediately after moving.

The old columns and cross-girders were now removed and the gap in each longitudinal girder (its ends resting on the timber towers) was bridged by a steel plate bolted



WORK PROGRESSED FROM LEFT TO RIGHT, ALL SLIDING OF STRINGER SPANS BEING DONE AT NIGHT

to the bottom flange, so that the two parts would move together in sliding. Narrow clearance between the timber towers, and the presence of the overhead trolley wires of the street-car tracks, made the steel removal slow work.

Moving was done at night, the old stringers and the new span being moved together. For this purpose, two three-sheave lines, one at each end of the new span, were fastened between chains hooked to the lower flange of the outside new stringers. After midnight, the contractor was given the privilege of single-tracking the traffic. On the track that was put out of service, the rail-and-tie floor was lifted clear of the stringers by derrick car, and two hoisting engines hauled in on the sliding falls. As precaution against any movement of the opposite track, its stringers were wedged against the stiffeners of the new cross-girders at each end of the new span.

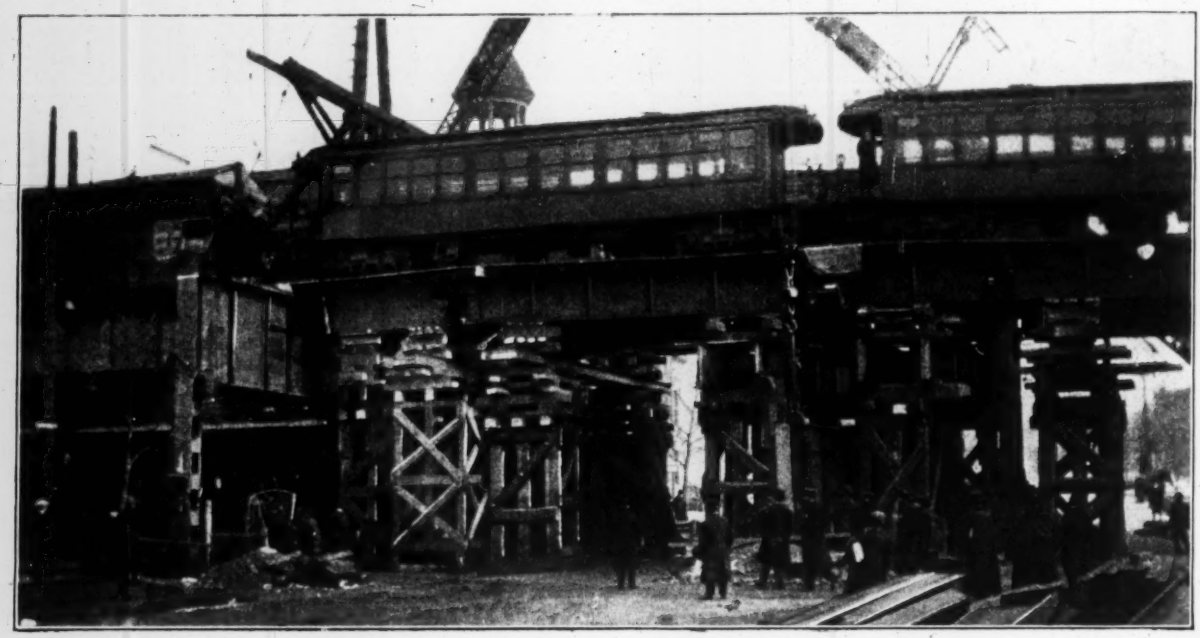
Sliding the stringers over to place, a distance of about 6 ft., took usually about 3 to 5 minutes. Then the shoring was again carefully examined, and after dropping the track floor down onto the new stringers, the shifted track could take traffic and the opposite track be put out of service and its stringers moved similarly.

After both tracks were in their final position, the stringers of the middle (express) tracks were set, the new transverse bent was pulled over to plumb, and the stringers securely bolted to it.

Temporary track conditions always existed in the span adjacent to a completed span, because here the track had to be swung 2½ ft. to bring it from the 13-ft. spacing of the old tracks to the 18-ft. spacing of the new tracks. To make this possible, just after a set of stringers was slid to final position the forward ends of the old track stringers in the span just ahead were slid over by steamboat ratchets, and the track lined up to match.

In all shifting of tracks the gage was never disturbed, as the tie spikes were never removed. The track was raised entire and shifted to the temporary or new final position by jacks and crowbars. The time consumed in this work was minimized by burning off the heads of the tie hook bolts under the stringer flanges, instead of unbolting.

This method of working was carried through successfully and rapidly. The contractor averaged two spans a week. The work was done in charge of A. J. Fearing, Division Engineer of the New York Municipal Railway Corporation, and was handled directly by Henry D. Mason, Superintendent for the Crenshaw Engineering and Construction Co., Inc.



OLD SPANS BURNED AT NEW BENTS IN ERECTING THROUGH-TRACK STRUCTURE THROUGH AND AROUND OLD ELEVATED WITHOUT DISTURBING TRAFFIC

Oil-Lease Suit Delayed Filling of Reservoir

The spring rains for the first time filled the new Mahoning River regulating reservoir at Milton, west of Youngstown, Ohio. In February, water was coming along fast enough to fill the reservoir, but because of a suit over oil leases at the upper end of the basin the water was held down to about 7 ft. from the spillway by manipulating the four sluice gates. At one time, however, the four gates failed to keep the water down, and the level rose to 4 ft. from the spillway crest with all gates open. Freezing weather checked the flow of the stream, and the water dropped again. The oil company secured a verdict of $1 against the city; thereupon the reservoir was allowed to fill, water flowing over the crest on Mar. 9. Frank M. Lillie, city engineer of Youngstown, who is in charge of the reservoir, states that there is no leakage, except some small amount at the expansion joints of the concrete spillway, and this leakage is decreasing. He says that there was no leakage whatever through the earth embankment that forms the main part of the dam.

Lumber Man Discusses Army-Camp Construction

R. S. Kellogg Tells of Speedy Work Done at Several Sites and Outlines Features of Government Specifications

HOW wood will enter into the Government's war preparations was explained at the World's Salesmanship Congress in Detroit recently by R. S. Kellogg, Secretary of the National Lumber Manufacturers' Association. He said, in part:

"An example of the speedy construction possible with wood is that of the building of the quarters for the Reserve Officers' Training Camp at Fort Sheridan during the first 10 days in May. The contract was awarded to the construction company in Chicago, on Saturday evening, Apr. 28. About noon on Sunday, Apr. 29, the order for the material, amounting to a total of some 1,400,000 ft., was placed. During the afternoon five motor-truck loads of lumber were dispatched to Fort Sheridan to provide quarters for the working force engaged on the job. At 5 o'clock in the evening a train of 50 empty cars was on track in the yards of the lumber company. The entire train was loaded with 1,400,000 ft. on Apr. 30, out of the stock of Northern, Southern and Western lumber carried on hand. The contract called for all dressed lumber. The most remarkable part of the operation, therefore, was that 400,000 ft. of the shipment was run through the planing mills of the lumber company and also loaded on cars in the same day.

Job Finished in 10 Days

"The trainload of lumber was delivered at Fort Sheridan on Tuesday morning, May 1. The construction company had its force on the ground equipped with gasoline saws and all other devices for quick work. Ohio National Guard engineers staked out the streets and buildings. The job was finished May 10, in just 10 working days, using only one shift per day. The largest number of men employed on the job at one time was 785.

"Here is the list of structures built complete, ready for occupancy: 42 barracks, 20 x 126 ft. each; 21 mess buildings, 20 x 110 ft. each, equipped with tables and benches built in regular logging-camp style; 21 lavatory buildings, 16 x 63 ft. equipped with toilets, shower baths, etc.; 1 post exchange building, 20 x 30 ft.; 1 telephone exchange building, 20 x 33 feet.

"Quick work of the same character has been done at Fort Benjamin Harrison, Ind., at Fort Oglethorpe, Ga., and other points. At Fort Oglethorpe 136 buildings were erected in 12 days (see *Engineering News-Record*, May 31, p. 468 and June 7, p. 506).

"The Government is planning for mobilization camps throughout the United States, to take care of the new army of one million men. Many of the buildings will be one-story structures of considerable length, although some of two stories are also planned. They will be of plain construction, but of modern type, with the most improved sanitary arrangements. They are expected to be the cleanest, best-arranged and most up-to-date barracks the world has yet seen provided for any army.

"There will be many cantonments. Arrangements are being made to use the kinds of timber most available in each locality. The Committee on Lumber of the Advisory Commission to the Council of National Defense has worked out specifications for the species and grades best adapted to each region—making these specifications interchangeable so as to permit either the purchase direct from the manufacturers or the use of accumulated yard stocks in the hands of distributors, as may be determined.

Lumber Estimate Involves Big Figures

"The estimate, based upon War Department plans, amounts to a total of 13,519,334 ft. for the construction of a standard camp to care for an infantry division of 25,000 men. There are 61 items in the specifications, some of the larger quantities of which, for example, are 1,249,848 ft. of 2 x 4 in., 8 to 16 ft. SISIE (smooth 1 side, 1 edge) for studs and girts; 318,790 ft. 2 x 6 in., 10 ft. (8, 12 or 16 ft. accepted) SISIE for floor joists; 213,132 ft. 2 x 6 in., 14 ft. rough for sills (double); 1,050,562 ft. 6-, 8-, 10- or 12-in. siding SIS, 8 to 20 ft.; 3,021,092 ft., 6- to 12-in., SIS random lengths for roofing and subfloors; and 1,696,764 ft. 3- to 6-in. random-length flooring. Each standard cantonment will also require 22,000 No. 2 stock sash of six or nine lights and 6000 Nos. 1 and 2 stock doors.

Specifications Interchangeable

"As an example of the way in which the specifications have been made interchangeable for different regions, the dimension stuff for studs and girts may consist of merchantable spruce framing in New England; No. 2 common hemlock in New York and Pennsylvania; North Carolina pine along the Atlantic Coast to Georgia; No. 2 common Southern yellow pine or cypress in the Gulf States; No. 2 common hemlock, Norway pine or tamarack in the Lake States; No. 2 common fir or hemlock on the North Pacific Coast; No. 1 common Douglas fir or larch in the Inland Empire; No. 2 Douglas fir, Western hemlock or merchantable redwood in California, or sound and square edge yellow poplar or chestnut in the hardwood regions. In siding, the specifications permit No. 2 merchantable spruce boards in New England; No. 1 common hemlock in New York and Pennsylvania; No. 4 North Carolina pine along the South Atlantic Coast; No. 2 common Southern yellow pine or cypress in the Gulf States; No. 1 common hemlock, Norway pine or tamarack in the Lake States; No. 1 common fir or hemlock on the North Pacific Coast; No. 2 common Western or Idaho white pine, fir, larch or spruce in the Inland Empire; No. 2 common Western white pine, or No. 1 common Douglas and white fir or merchantable redwood in California; sound and square edge yellow poplar and chestnut in the hardwood regions.

Lumber Committee's Recommendations

"In the detailed schedule for these materials, the Lumber Committee made the following recommendations:

"1. That all cantonments built north of the thirty-fifth degree of latitude be double-floored and sheathed in accordance with the alternative items listed, with a cheap grade of rosin-sized building paper between lin-

ing and flooring, and between sheathing and outside finish respectively. This is regarded as essential to the health of the troops in winter and as an economy in reduction of heating costs.

"2. That in any event, 4- or 6-in. D and M siding, laid vertical, be substituted as far as obtainable for the boards and battens called for by the specifications. This is in the interest of a tighter and neater surface finish.

"3. That in the same latitudes and for the same reasons triple-ply composition roofing, or a cheap grade of shingles (namely, 4-in. sound butts in the Lake States or standard A grade in the Pacific Northwest) be used for surface roofing.

"4. That for durability and service, No. 3 hardwood strips be used for surface flooring wherever obtainable; also that hardwood threshold be used at exterior doors.

"5. That ground posts, except cedar, redwood or cypress, be given a brush coat of creosote.

"6. That a standard specification as to size and spacing of nails be incorporated in all contracts for the building of cantonments."

Record Construction on San Francisco Office Building

A Pacific Coast record is claimed for the rapid progress that has been made on the Southern Pacific office building now being erected on lower Market St. in San Francisco. The building is 10 stories high and has a total of 378,000 sq.ft. of floor space. The first pile was driven in the foundations on Sept. 1, 1916; the first steelwork was put in place on Dec. 4; the last pile was driven Jan. 15, 1917, and the steel frame was completed Mar. 15. On May 1 the structure was closed in and 70% complete, practically all of the brickwork having been finished. The building is to be ready for occupancy Sept. 1.

Interest attaches to the work because of the carrying of such heavy weights on soft foundation. The structure is located on filled ground, and in the foundations were placed 2600 piles, some of which were 135 ft. long. A specially constructed 10-ton steam hammer was built to handle these piles. The specially constructed piledriver was described in *Engineering News* of Sept. 14, 1916, p. 509.

Part of the first floor and all of the building above the second floor will be occupied by the Southern Pacific Co. The freight auditing department will be accommodated in a single room that has 36,000 sq.ft. of floor surface and is 750 ft. long. It is not planned to open the windows in this room, as a ventilating system that will provide ample changes of air has been installed.

The equipment includes steam-heating system, sprinkler system for fire protection, and vacuum lines for cleaning purposes. One hundred and thirty thousand square feet of glass is on order, and the pneumatic tubing system will require about six miles of tubing. The water supply, except that used for drinking purposes, will be provided by a well now being sunk on the premises.

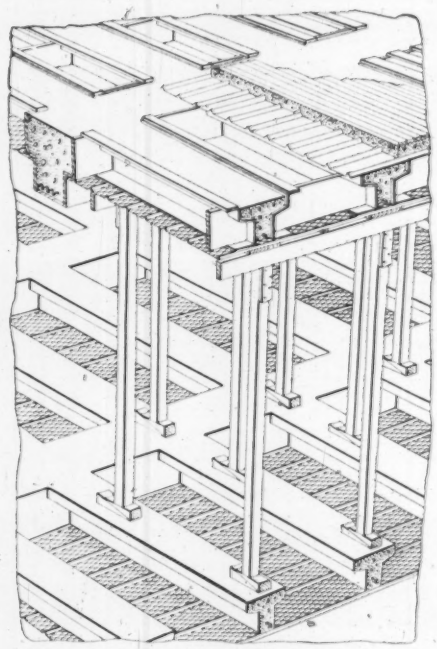
Contract for the foundations was held by the Healey-Tibbetts Construction Co. The general contractor is the Lindgren Construction Co. J. Q. Barlow is assistant chief engineer of the Southern Pacific Co.: G. B. Herington is in immediate charge of the work.

Special Forms Permit Light T-Beam Concrete Floor System

Pressed Metal Forms When Removed Upward Leave T-Beams on Which Cinder Concrete Floor Is Placed

IN THE new building now being erected for the Federal Trade Commission at 15th and K Sts., N. W., Washington, D. C., a new type of reinforced-concrete floor has been placed at what the designers claim to be a considerable saving in weight and hence in cost over any other fireproof floor of equal strength. The design is controlled by patents held by the T-Beam Engineering Co., of Washington.

The floor consists of rows of small concrete beams or joists of T-shape poured monolithically with their supporting beams or girders between forms made up of spacing members or boxes of wood and cores of bent sheet metal. The accompanying perspective shows the general layout of the system, which may be used either on steel-frame or on reinforced-concrete buildings. The new building at Washington is of reinforced concrete.



PERSPECTIVE OF LAYOUT OF SYSTEM

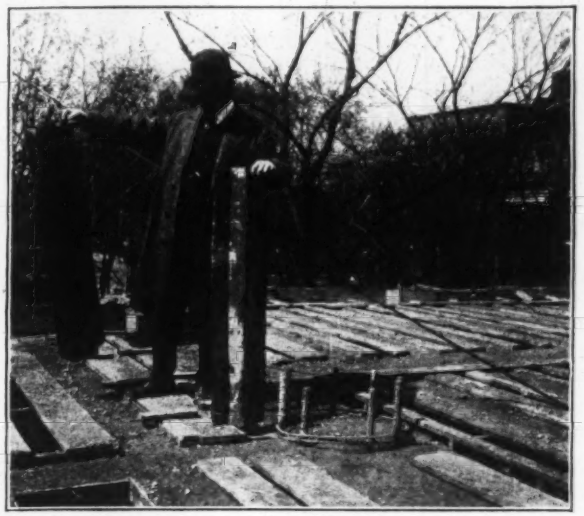
Construction Details

In building the floor, a line of struts is placed in each lower T-beam and capped with plank that serve as beam bottoms. On these plank as joists is then laid expanded or ribbed metal that forms a ceiling base. Then metal forms bent to the shape of one side of the T-beam are placed over each plank and held in position by properly cut brace boards between beams and by stiffener planks along the top. In the T-form thus made, the proper reinforcing is placed and the concrete poured to make the T-beam.

When these beams have set, the bracing boards are knocked out and the beam metal forms released to be

taken upward and used on the next floor above. The beams are then overlaid with another sheet of expanded metal, and the usual cinder concrete floor is placed. For the upper (floor) layer a fireproof board could be used in place of expanded metal.

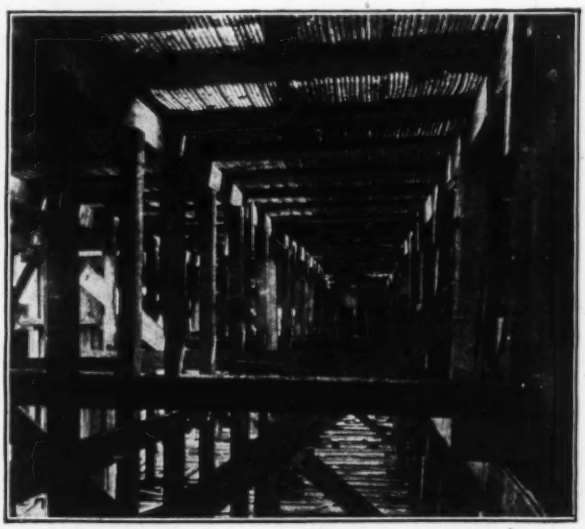
In the Washington building the beams are 28 in. c. to c. with stem 6 in. deep and 4 in. wide and with flange 11½ in. wide and 2½ in. deep. This leaves a 17-in. open-



FORMS AS RELEASED FOR NEXT FLOOR

ing between flanges, which is spanned by the 3½-in. cinder-concrete floor unreinforced except for the expanded-metal base. The metal forms are of No. 24 gage sheet iron and were turned out to proper shape by a local tinsmith.

The basement columns of the building were poured Mar. 11, 1917, and the last of the roof concrete was placed May 19, 1917, the 12 floors and roof, all 35 x 103 ft. in plan, being completed in that time. This allows about 4.3 working days per floor.



STRUTS CAPPED WITH PLANK CARRY FORMS

LAYING EXPANDED METAL FOR FLOOR

The building was designed by B. Stanley Simmons, architect, and is being built by the Michael A. Weller Construction Co., both of Washington.

Condensation Under Various Types of Roofs Shown by Tests

Determine Relative Effectiveness of Various Materials —Curves Show Relative Humidity That May Be Carried

A SERIES of experiments to determine the relative effectiveness of various types of roofs in preventing the formation of condensation upon their under surface has been conducted by F. P. Sheldon & Son, engineers and architects, of Providence, R. I. The results were reported in some detail at the recent meeting of the National Association of Cotton Manufacturers by A. N. Sheldon, of the firm. The tests have especial interest because of their relation to the decay of wood roofs due to moisture conditions following condensation.

Tests Made on Small Box

The tests were made on a prototype of an actual building, consisting of a box about 4½ ft. square and 20 in. deep, so constructed as to receive as one face a roof specimen 3 x 4 ft. in plan and so arranged as to permit interior variation and observation of moisture and temperature conditions.

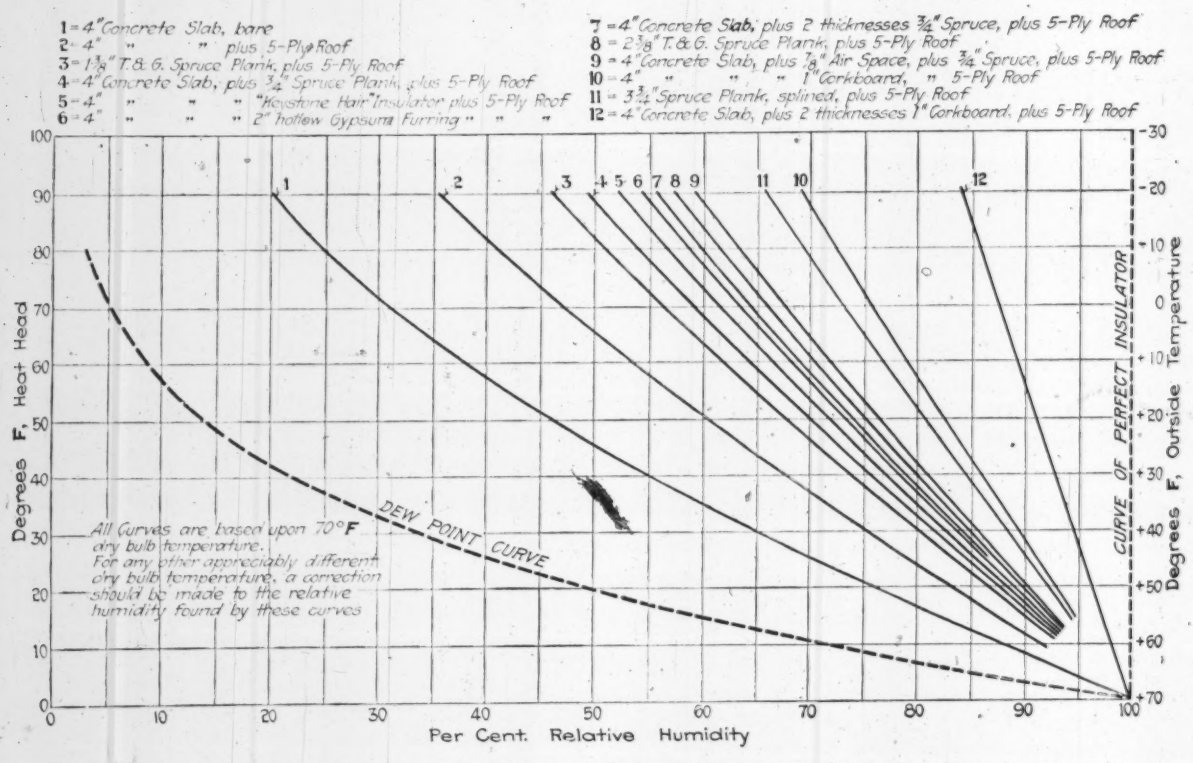
Each sample roof was tested under three different conditions of heat-head to obtain results corresponding to outside temperatures of about 20° F., 0° F and —20° F. for a given inside temperature of 70° F. in each case. Formation of condensation on the under side of the roof was noted, occurring of course when the dewpoint of the air within increased and became equal to or higher than the temperature of the surface in question.

These tests embrace concrete and plank roofs with various types of insulation, and a curve was plotted on the three temperature points noted, relative humidities being used as abscissas, and heat-head, or temperature difference, as ordinates. The curves obtained for various sample roofs are shown herewith. Since they are based on 70° F. dry-bulb temperature, the corresponding outside temperatures, as well as heat-heads, are also shown as ordinates. Each full-line curve represents

some particular roof, and from it may be read directly the relative humidities at which, for any given temperature, these tests show that condensation can be expected to take place.

All curves are prolonged through a common origin, which is a theoretical point based on 0° heat-head; that is, if the temperature of the air on both sides of a roof of any material is the same, condensation will not occur until 100% relative humidity is reached. Starting from this point, two interesting theoretical curves may be drawn, as indicated by dotted lines. They constitute the limiting curves between which all materials whatsoever, from the most perfect conductor of heat to the most perfect insulator, must fall. The first, which is a vertical at the extreme right, is the line of the perfect insulator. It is purely theoretical and illustrates that, if it were possible to obtain such an insulator, 100% relative humidity could be carried at any difference in temperature between the outer and inner surfaces, because there would be no flow of heat and consequently no temperature gradient within the material; that is, the surface temperatures would be exactly the same as the air with which they are in contact.

The second curve at the extreme left is designated the "dewpoint curve" and represents the depression of the dewpoint (based on a dry-bulb temperature of 70° F.) for various relative humidities from 3 to 100%. This curve is also purely theoretical and illustrates that the poorest insulator will carry somewhat greater relative humidities than those indicated.


1 = 4" Concrete Slab, bare
2 = 4" " " plus 5-Ply Roof
3 = 1⅛" T. & G. Spruce Plank, plus 5-Ply Roof
4 = 4" Concrete Slab, plus ¾" Spruce Plank, plus 5-Ply Roof
5 = 4" " " " "Keystone Hair" Insulator plus 5-Ply Roof
6 = 4" " " " 2" hollow Gypsum Furring " " "
7 = 4" Concrete Slab, plus 2 thicknesses ¾" Spruce, plus 5-Ply Roof
8 = 2⅜" T. & G. Spruce Plank, plus 5-Ply Roof
9 = 4" Concrete Slab, plus ⅞" Air Space, plus ¾" Spruce, plus 5-Ply Roof
10 = 4" " " " 1" Corkboard, " 5-Ply Roof
11 = 3¾" Spruce Plank, splined, plus 5-Ply Roof
12 = 4" Concrete Slab, plus 2 thicknesses 1" Corkboard, plus 5-Ply Roof
Degrees F. Heat Head
Degrees F. Outside Temperature
CURVE OF PERFECT INSULATOR
DEW POINT CURVE
All Curves are based upon 70° F dry bulb temperature. For any other appreciably different dry bulb temperature, a correction should be made to the relative humidity found by these curves
Per Cent. Relative Humidity

CURVES SHOW RELATIVE HUMIDITY THAT MAY BE CARRIED WITHOUT CONDENSATION BY DIFFERENT ROOFS

Wood Roofs Let Warm Moist Air Through Cracks

It should be noted that all these curves have reference to the particular relative humidity at which condensation will take place on the *under side* of roofs. With regard to wood roofs, there is another important consideration that must be taken into account; namely, the cracks between the plank afford a more or less direct channel by which the warm moist air in the room below may reach the under side of the roofing paper. Since the standard five- or six-ply tar and gravel roof is a poor insulator of heat, the temperature of its under surface is consequently but slightly warmer than that of its top surface. This results in a chilling of the air that comes in contact with it and the formation of condensation if the cooling is carried on beyond the dewpoint.

In buildings where artificial humidification is resorted to, or where the humidity is naturally high, Mr. Sheldon pointed out that this fact means nothing more nor less than that the first ply of roofing on the average roof of this type in this climate is wet during the greater part of the heating season. In a new building, moisture may not be evident until some time after erection, due to the hygroscopic property of the roof plank, the wood itself absorbing the condensation, if the deposition of the latter, on account of poor air circulation through the cracks, is not too rapid. But on a roof having wide cracks, condensation is certain to come sooner or later if the warm humid air of the room below comes in contact with the roofing paper. For this reason the top surface of the roof plank may be seeped with moisture, regardless of whether or not any condensation is present on the under surface.

Again, if cracks between the plank are so wide as to allow moderately free circulation of air, condensation often accumulates so rapidly as to run down the edges of the plank to the room below, manifesting itself in a line of drops at the cracks between the plank.

Mr. Sheldon says that this condensation is doubtless the direct cause for so much trouble being experienced at the present time with decaying wood roofs. If the temperature of the under side of the roof plank coincides with or is lower than the dewpoint for the particular humidity and temperature existing, there will be condensation upon this under surface and throughout the thickness of the plank; that is, in the cracks between the plank up to the under side of the roofing paper.

On the other hand, if the temperature of the under side of the roof plank is above the dewpoint, no condensation will be deposited here; but it may occur from the under side of the roofing paper down to a point somewhere within the interior of the plank, depending upon the heat gradient and the relative humidity. The presence of this moisture, due to the second cause—that is, within the roof plank—is a most active agency in providing the proper conditions for the development and rapid spread of disease throughout the roof. The prevention of condensation on the under side of the roof plank, while eliminating a nuisance in manufacturing, may not appreciably lessen the possibilities for decay.

It has been suggested that enough protection could be added in the form of more wood or other insulating material to the top of the roof to raise the temperature of the upper side of the plank to such a point as to prevent all condensation. And then, if data were made available by the forest pathologists as to the limiting conditions of relative humidity that various kinds of wood and different grades of the same wood can resist indefinitely without developing fungi, this information could be used in selecting the roof plank.

Condensation Thought Not Preventable

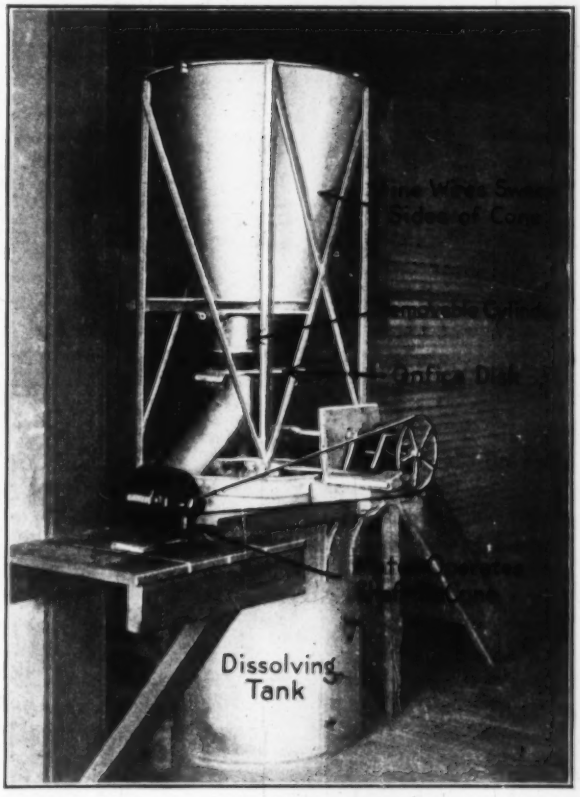
Invaluable as the above data on wood would be for use in the design of building interiors, such as beams, columns, floors, etc., Mr. Sheldon thinks that his experiments, confirmed by theory, indicate that the prevention of condensation on the top side of roof plank is impracticable for several reasons. First, the insulation would necessarily be so complete as to make the expense unwarranted. Also, if plank were used for this extra insulation, they should be antiseptically treated against rot, whereas it will be seen below that a fully satisfactory result will be attained at much less expense by the treatment of the roof plank only. Again, even if condensation within the area in question was prevented by this means, there would still be no certainty that plank selected as suitable for the room conditions would not rot, for the reason that the top side of these roof plank would be several degrees lower than the room temperature. This would result of course in a higher relative humidity than that existing in the room below, and consequently plank that might be suitable to resist decay under room conditions would not be so resistant under the actual conditions.

According to Mr. Sheldon, the successful solution of the problem of the design of wood roofs resolves itself into two requirements: The roof should be made thick enough, according to the accompanying curves, to prevent the occurrence of condensation upon its under surface. Secondly, it should be protected against decay, by proper preservative treatment.

Bottle-Tight Basin with Circular Baffles Withstands Ice

Simple Construction Methods Prove Successful—In Operation of Plant New Dry-Lime Feeder Is Developed

A CIRCULAR 3,000,000-gal. reinforced-concrete concentrically baffled reservoir at Bedford, Ind., has remained bottle-tight since construction three years ago. Although the reservoir is reinforced near the top for ice pressure, the water-department employees cut the ice the first winter, but for the last two winters no attention has been paid to this operating detail and no trouble has developed. This basin and a chlorinating outfit comprise the purification works for treating the turbid White River water for this city of 10,000 people. As a similar process has been proposed for the train-



DRY LIME FEEDS INTO REMOVABLE MEASURING CYLINDER

ing camp at Fort Benjamin Harrison, Ind., a description of the reservoir and its construction is here outlined.

The reservoir is located halfway up the bluff from the river to the city, to which water is delivered by motor-driven multistage centrifugal pumps under a total head in the two lifts of 525 ft. The 20-in. suction line, 660 ft. long, leads from a submerged concrete intake to a pump pit excavated in the rock to a depth of 8 ft., so as to be safe from the 26-ft. rise in the river at flood time. The present 3,000,000-gal. horizontal unit is being duplicated.

The circular wall of the reservoir is 160 ft. in diameter, 12 in. thick at the top, 26 in. at the base and 14

ft. deep to the floor, which is of spherical shape, giving a depth of 26 ft. at the center. The wall is reinforced for bursting and against temperature and unusual stresses. The 4½-in. floor was laid with ½-in. reinforcing bars two ways on the easily shaped clay. The two concentric baffles of 40- and 100-ft. diameter and 6-in. thickness are reinforced horizontally with ½-in. bars spaced 6 in. and vertically every 4 ft. with ¾-in. bars.

Construction Methods Simple

Construction of the reservoir was by a local contractor who did not have elaborate equipment. In consequence the wall was built in seven sections, the end of the forms being removed after six to eight hours and the fresh concrete roughed with a pick. The concrete consisted of 1 part cement to 2 parts of sand carefully prepared from a fine and coarse grade, and 4 parts of broken stone passing a 1½-in. mesh. The material that went into the concrete was checked by weight by the inspector and was held in the mixer at least one minute after sufficient water was applied to give a pasty concrete that would roll or crawl down the chute into the wheelbarrows. Care was taken to spade the concrete in the forms by a special spade of ½-in. metal 5 in. wide and 5 ft. long with a handle of pipe welded to the blade.

The vertical reinforcing was held in the footing, and the horizontal bars were extended through the end gates to form sufficient laps for the following section.

Regardless of the number of vertical joints and absence of special waterproofing, the reservoir when tested proved practically bottle-tight. The tests were specially severe, as the original specifications called for the continuous deposition of concrete and were only modified when the contractor gave bond to guarantee tightness under his piecemeal method of construction. On filling with water, no leaks were discernible on the walls, and after deducting for evaporation the drop was inappreciable after five days. Then, by order of the engineer, water was turned into the trench outside of the wall, so as to be able to detect more easily any perceptible leaks. This pressure from the outside disclosed two small damp areas. When the water was let out of the trench, the areas opposite were painted with asphalt; and subsequent test indicated that the small pores had been closed.

Operation Satisfactory

In operation, the incoming water, dosed with lime and iron, discharges inside of the inner concentric baffle behind two back-and-forth baffles, giving a rapid flow and mixing. Then the velocity is decreased to less than 1 ft. per sec., and most of the sediment settles within inner concentric baffle, from which it is removed, without draining the basin, by opening the central blow-off and admitting water under pressure through a pipe laid alongside the foot of the baffle wall. The water issues in jets from a series of short ½-in. pipes screwed into tees in the main supply line. These small pipes are turned down at an angle of 30° and bent to discharge in the same tangential direction as the flow of the water. When the water is at its worst and the turbidity ranges up to 3000 parts per million, the sludge is blown off for from 10 to 20 min. each day. At other times, once a week is sufficient. So little sediment settles in the second and third concentric space that the whole floor is cleaned but once or twice a year.

Every two weeks, samples are tested by the analysts of the State Board of Health with results comparable in excellence to filtered supplies. The turbidity of the supply delivered to the consumer rarely exceeds 10 parts per million.

Dry Feeder for Hydrated Lime

An ingenious dry feeder for hydrated lime has been developed at this plant after experiments with several screw arrangements which are used in the handling of flour. The scheme consists of a conical lime-supply box in which is a revolving vertical shaft carrying narrow blades at top and bottom with fine wires connecting the ends to sweep the sides of the cone, thus preventing any arch action in the lime. The lower blade sweeps over the bottom, in which is an orifice feeding directly into a removable cylinder. The lower end of the cylinder is covered by a large disk revolved periodically by a timing clock. An opening in the disk permits the charge to fall into a mixing tank. Adjustment is easily made by putting in different-sized cylinders or varying the interval on the timing clock.

Experiments with agitators in the mixing tank finally led to the adoption of a 6-in. propeller set 4 in. above the bottom of the sloping sides. The incoming water plays in a jet against the propeller and rising after being thoroughly mixed, overflows at the top.

The basin and other improvements to the Bedford water-works were designed and installed under the general direction of C. H. Hurd, consulting engineer, Indianapolis, with J. W. Malott superintendent in charge.

CONCENTRICALLY BAFFLED BASIN AT BEDFORD RETAINS MOST OF SEDIMENT IN CENTRAL COMPARTMENT

Status of Welland Ship Canal

About $13,000,000 of the total estimated cost of $50,000,000 has been spent to date on the Welland Ship Canal. The work has been suspended on account of the war.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Land Drainage Affected by High Prices

Sir—I have read with interest in your issue of June 7, the editorial "Land Drainage Needs Pushing," and I quite fully agree with you that it does; but it seems that there is more possibility of land drainage ceasing entirely than of its being extended.

The prices for fuel, wire rope, labor and food are making it almost impossible for contractors to carry on this work at a reasonable figure. The prices within the last two years have been about 10c. per cu.yd. for ditch work and 12 or 13c. for levee work. Now, however, the price is far in excess of this. I note that the Mississippi River Commission has just rejected a bid on the Sny Island drainage district, where the contractor bid 61c. per cubic yard.

I am very fully of the opinion that we need a drainage act similar to the reclamation act, under the terms of which the arid lands of the West have been reclaimed. Certainly these wet and overflowed lands, so close to the center of population and so close to transportation, should be reclaimed promptly. E. T. PERKINS.

Chicago, Ill.

Treating Packing-House Sewage

Sir—Please publish a correction to an article which appeared in your issue of May 31, entitled "Marked Advance in Treating Sewage from Packing Houses," written by G. B. Zimmele. In conclusion No. 5, Mr. Zimmele stated: "The effluent is stable and so well purified that it is reused in the packing house like ordinary water." We do not reuse this water in the packing house in any manner whatsoever.

In conclusion No. 6, Mr. Zimmele says: "The problem of dewatering the sludge has been solved, at least for packing-house sludge, and the process patented." In this connection it would be well to say that this acid treatment gives better results with Fort Worth sludge than with sludge produced in other sections.

G. L. NOBLE,
Assistant Superintendent, Armour & Co.

Chicago, Ill.

Will Engineering Council Secure Coöperation of Engineers

Sir—I have read with considerable interest the letter from C. E. Drayer in your issue of May 3, also the suggestions for amendment to the by-laws of the United Engineering Societies. I was also present as a delegate at the third annual conference of the Committee on Engineering Coöperation, which conference adopted a set of resolutions intended to pave the way for more cooperation and united effort of all the various engineering societies throughout the country. At this conference there was presented in a paper the suggestion of organizing a new society, to be known as the "Engineering Civic Federation."

All these moves show beyond doubt that the engineers throughout the country feel the need of more unified action on the part of the profession as a whole. If this need is as universally felt as I believe it is, there can also be no doubt that it will eventually result in the success of one of these coöperative movements; and to be of lasting benefit, the successful movement must be of such nature that it will benefit *all* engineers, reaching those who are *not* members of certain societies as well as those who are. Such a movement must in some way or other reach out a helping hand to our draftsmen, levelmen, instrumentmen, etc., for among these are our future engineers and leaders in the profession. Every reader of this letter has been numbered in those ranks.

In the writer's opinion, there are three main essentials in the organization of that movement which will ultimately succeed: (1) Democratic representation and control; (2) a responsive and responsible central government; (3) a liberal policy toward local units in the management of their local affairs (home rule).

1. Democratic Representation and Control—By this is meant that each and every member of the profession who definitely allies himself with his profession and its members should have as direct a voice as possible in the government of the profession. To state this a little more in detail, the central governing body of whatever crystallizes from this movement must be composed of members who have been selected in such a manner as to give each and every member a direct voice in their selection. The more stepping stones placed between the members and the governing board the farther you get from a democracy.

2. A Responsive and Responsible Central Government—This is of course an absolute essential for the success of any organization or movement. If any such movement is to be democratic, if it is going to serve the needs of the profession and result in real coöperation, it must be governed by a body of men who will respond to the needs and desires of those who compose the organization. Besides being able to respond readily to the needs of the various units composing the organization, this governing body must be clothed with powers sufficient to give it true and efficient responsibility.

3. A liberal policy toward the local units in the management of their local affairs may be considered as a safety valve which will some day save the entire movement or organization from destruction (from within).

Does any movement so far started provide these essentials?

There are really two movements on foot at present which provide for coöperation of existing engineering societies—namely, the Engineering Council of the United Engineering Societies, and the Committee on Engineering Coöperation.

In discussing the recommendations for establishing the Engineering Council of the United Engineering Societies, I must admit that I am an outsider endeavoring to look in, but at the same time sincerely hoping that those on the inside are endeavoring to look out and see the needs of that part of the profession not represented within. In the first place, the Engineering Council is recommended in order to provide for convenient coöperation between the four Founder Societies for the purpose of consideration of questions of general interest to engineers and to the public. . . . This is a broad

and necessary field, we must all admit, but one which is to be handled only by the four Founder Societies, representing perhaps 40% of the profession.

We further find that "the trustees of the United Engineering Societies may elect to membership in the Engineering Council other national engineering or technical societies . . . provided their nomination . . . have the unanimous approval of the governing bodies of the four Founder Societies." This shuts out all hopes of the 60% not now represented of *ever* being represented in a coöperative movement "for the proper consideration of questions of general interest to engineers (themselves), unless they join some *national* society.

It is far from my intention to criticize in any way the four Founder Societies for entering into any form of movement they desire, but would it not be better in launching such a movement that they also make provisions for including those societies in excess of that of these local societies? Would this not result in far more benefit to the entire engineering profession, and *therefore* to the four Founder Societies?

The Committee on Engineering Coöperation at its third annual conference passed a resolution asking the national societies to "create machinery necessary to provide for a general permanent body made up of representatives of the various national, state and local engineering organizations. . . ."

It furthers appears to me that the General Committee which framed the outline of the Engineering Council departed quite radically from the principles of both democracy and home rule when it provided that "each Founder Society shall have five representatives upon the council, and such representatives shall be designated by the governing body of such society." Why should the council endeavor to dictate the method by which each society should choose its delegates? Should not each society be free to choose its delegates or representatives according to its own pleasure? The tenth paragraph of resolution A passed by the Committee on Engineering Coöperation states, "A conference of representatives from each engineering organization . . . ," leaving the method of choosing those delegates to the various organizations themselves.

In conclusion, I fully realize that I have only mentioned those points in the formation of the proposed Engineering Council which to me seem not to be desirable. I have done this because I feel the good points will stay without special comment, and not because I feel there are no good points. To be a success and of real service, this coöperative movement must be a broad one; it must be one which will reach a majority of the profession and not confine itself to the national societies representing but a minority. It will require much thought and labor in working out details, but if properly launched and equipped will be of immeasurable value.

J. C. PINNEY,
Superintendent Bridges and Public Buildings,
Milwaukee, Wis. Department of Public Works.

How To Guard Against Overstressed Counters

Sir—The interview on "Tendencies in Bridge Construction," published in *Engineering News-Record* of June 14, p. 541, is a departure in scientific journalism and gives a live interest to a bone-dry subject. The article holds the attention of the reader from beginning to end.

The continued increase of railroad-bridge loading and the constant renewal of bridges, which are scrapped for no other reason than overloading, have very properly received much attention. In 1890 the Erie R.R. was designing bridges for an engine concentration of 24,000 lb., and at that time I was instructed by C. W. Buchholz, chief engineer, to select an engine loading which would "cover all future possible increases." To this end, after extended study and consultation with locomotive designers, I recommended a loading which seemed at that time to cover the purpose and which corresponded to the present E-35 engine. This, when compared with the E-24 then in use by the road, seemed so extreme that it was only after most urgent insistence that the increase was adopted.

This proved to be only the beginning of the increased loadings, and within 10 years the specified loads exceeded those of 1890 by nearly 100%. These changes led to improved methods of proportioning, to the careful study of impact and to increased allowable stresses and finally, where the bridges in early years were scrapped when the strains exceeded 15,000 lb. per sq.in., they were later, with allowance for impact, permitted to reach 20,000 lb. per sq.in. or even more.

But now again we are on the threshold of another step of progress. In the examination of overloaded bridges we find the first overstrain in the counter members of trusses. The strain of main members may be well within safe limits, yet the counters will have passed the danger point and the bridge must be patched or scrapped on that account.

It does not require much argument to show that these bridges are still being designed under a wrong premise. In 1890 the allowable strain for combined dead-load and live-load was 8000 lb. per sq.in., to cover impact and other "factors of ignorance." When provision was made for impact this allowable strain was increased to 16,000 pounds.

Yet these same bridges we are now beginning to scrap when the strains reach 20,000 lb., and the defect is usually found in the counter members.

It was to avoid these conditions that the author, in a paper "Specifications for Bridges and Subways" (*Trans.* Am. Soc. C. E., Vol. LXXV, p. 325), suggested that, instead of designing with an allowable strain which could be increased in service, we should at once use that increased strain and at the same time use an increased load which we could anticipate would produce that strain; that is, if we anticipate an increase of 25% in allowable strain before the bridge is scrapped, we should design with an increase of 25% in the assumed loading, which we might term a "contingent increase." This would make the proper provision for anticipated increase in counter members. Where a bridge is required for engine E-40 with 10,000 lb. allowable strain, we should make the calculations for E-50 with 20,000 lb. allowable strain; or where engine E-60 with 16,000 lb. is required, we should proportion for E-75 with 20,000 lb. allowable strain. This will build a more economical and a better-proportioned bridge.

HENRY B. SEAMAN,
New York City. Consulting Engineer.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

IT HAS been noticeable that engineering organizations of the West with radically different purposes have recently accomplished much along the same line—namely, an increase in the scope and responsibility of the engineer. In order to secure some definite idea of this movement, *Engineering News-Record* has made a canvass of Pacific Coast organizations, asking about the aims and recent accomplishments of each. The following review of the situation is presented:

PROGRESS IN CALIFORNIA

The San Francisco Association of Members, Am. Soc. C. E., in addition to the usual meetings and inspection trips, has undertaken the preparation of a report suggesting improvement of civil-service laws, has coöperated with the Industrial-Accident Commission in the form of building-construction safety orders, has successfully fought a legislative act intended to impose upon engineers the necessity of obtaining an architect's license before designing or constructing buildings and has assisted in an industrial and professional survey of the state in conjunction with the War Department.

The Southern California Association of Members, Am. Soc. C. E., considers it within its province to "participate in and exercise its influence when an expression of engineering views will contribute to the general public welfare." In connection with other work of this sort it has been active in framing a bill for a proper regulation of court procedure as to expert witnesses. This has been directed toward "raising the present status of expert witnesses from unenviable notoriety to one of honor, and to the better attainment of the ends of justice."

THREE AIMS IN VIEW

This society works on the policy that engineering knowledge is advanced less by formal papers than it is by talks from notes, illustrated by lantern-slide projections, of methods of construction and the handling of equipment. In this manner the subject is visualized and impressed more effectively, at the same time that it encourages discussion. This society works toward a threefold end: (1) To bring the members together and thus (2) encourage the interchange of engineering knowledge and engineering experience and ideas, and (3) to facilitate active participation in public affairs in so far as these come within the province of the engineer.

The Engineers and Architects Association of Southern California is still the largest organization of its kind on the coast, having over 300 members. Although many of these have joined national organizations, they have not left the ranks of this local society. It is open to engineers and architects of all branches without requiring high attainments in their several professions. The result is that a considerable part of the membership consists of younger men, and the plan of operation of the organization is laid out to benefit a membership with widely divergent interests.

The association emphasizes the difference between keeping out of politics and shirking action in those public matters that affect the engineer. Thus its committees, which have been regularly at work on all legislation affecting engineering or architecture and building construction, have enabled the association to see that engineers had adequate representation in such matters. The organization believes in the advantages of informal association such as is gained on inspection trips, and many of its meetings are "in the field."

Los Angeles has a joint committee of technical societies consisting of four resident members from each of the seven technical societies—namely, American Chemical Society, American Institute of Architects, American Institute of Electrical Engineers, American Institute of Mining Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, and Engineers and Architects Association of Southern California.

ASSOCIATION ACTIVITY IN THE NORTHWEST

The Oregon Society of Engineers has established a monthly bulletin for circulation among its membership, calculated to bring the members closer together. An employment department under the direction of the secretary has come to be generally known among employers and has been the means of helping members to find jobs in a most satisfactory way.

The Seattle Association of Members, Am. Soc. C. E., has been working actively for some time on the policy that the local association in western territory must be made the active energizing unit of the parent society, and work has been directed toward strengthening the status of the association along the lines of this ideal. During the past year this association assisted in organizing the Associated Engineering Societies of Seattle. It also used its influence successfully in securing the passage by the legislature of a state water code, as well as securing the defeat of an architect's license bill that included a clause inimical to the engineer.

It is notable that every one of the Pacific Coast engineering organizations has recognized that it is in a position to do much toward preparing inventories of resources that the Government might wish to utilize in war times and in many other ways to assist in preparatory measures. For example, the Seattle association, with a membership of only 90, has two members on the Naval Consulting Board, four majors and two captains in the Officers' Reserve Corps and two members with the Canadian contingent at the front. One-quarter of the membership had volunteered for service shortly after the declaration of war.

St. Paul Meters 64% of Water-Supply

The City of St. Paul, Minn., with 272,000 population (214,000 consumers), has 64.15% of its water-supply metered. The consumption is 55 gal. per day per inhabitant, or 70 gal. per consumer. The annual report of the Water Commissioners states that the city furnishes about 60% of the water. The remainder is from artesian wells, which mainly supply what would otherwise be large consumers. These individual services have no connection with the city's water-works system and are not included in its statistics.

THE ENGINEER IN FIELD AND OFFICE

A DEPARTMENT DEVOTED TO DETAILS OF THE DAY'S WORK

Willow Root Stops Water Main

By Gale S. Strout
San Francisco, Calif.

THE accompanying view shows two sections of the root of an ordinary willow. These are sections from a single root 21 ft. long that was removed from a 10-in. water pipe. The smaller of the two is the parent root and is ½ in. in diameter at the point at which it entered the pipe. Three feet inside of the pipe it completely filled and blocked the passage for a distance of 4 ft., at which point it tapered down slowly to a single hairlike feeder at the end.

WHAT WILLOW ROOT DID

This root represents the growth of but one year. The pipe was thoroughly cleaned at this point a year ago, and a hole left in the pipe at that time was the entrance of this trouble maker. The root was taken from a 10-in. collecting main in the system of the Petaluma Power and Water Co. by the company's superintendent, F. D. Ellsworth.

Automobiles Facilitate Survey Work

THE value of the automobile as a substitute for team outfits in increasing the efficiency of the engineer force on surveys for large construction work is dealt with in the June number of the *Reclamation Record* by O. T. Reedy, construction engineer, United States Reclamation Service. The work was the Laramie unit of the North Platte irrigation project in Wyoming. It included the construction of 42 miles of main canal and the advance location and cross-sectioning for a 20-mile extension. Four automobiles are now operated; while their primary service has been for supervisory work, all of them have been used more or less on survey work.

In one instance, a field party had charge of about 11 miles of heavy canal construction, including two siphons and two tunnels 2700 ft. and 2150 ft. long. Their work increased until it was evident that a second party would be required, as the men often had to do their surface work by day and a considerable part of the tunnel work by night. Analysis showed that 30 to 50% of the time was spent in going from job to job and that the one party could handle all the work if provided with a car to reduce this lost time. This was done and proved entirely satisfactory.

The cost of an automobile delivered is given by Mr. Reedy as $403, and $459 for a team, spring wagon and harness. The saving was about $497, as the car took the place of two team outfits, which were then transferred to construction work. There was also the saving of the salaries of one engineering party—at least $230 per month. The cost of operation of the four automobiles and of team outfits at four camps on the work is given in Table I.

The monthly expense for three months of car G in survey work exclusively was $37.55, distributed as shown in Table II. This was in the winter, which accounts for a considerable increase in the expense. For supervisory work it was possible to select the milder days, but for survey work the car had to be in service daily, practically regardless of road and weather conditions, on account of the requirements for giving line and grade in the several tunnel headings. The survey cars also traveled over the most difficult roads on the work, aside from their condition due to winter weather. The cars on supervisory work traveled over these same roads, but also over fairly good roads, so that their average expense was less.

In Mr. Reedy's opinion the cost for automobile G for the nine-month period (Table I) in which it served for both supervision and survey work is about the average for an automobile used exclusively on survey work the year round and on the average roads on this job. He points out that while this is the highest monthly cost for any automobile, it is lower than the lowest team cost. The team of Box Elder camp is more nearly comparable with that of automobile G, and there the average cost was $36.60, or 30% more than for the automobile. However, this camp had been established only three months. Probably its team cost would be reduced later to that of Cherry Creek camp, or $30.12, which is a little less than 7% more than for the automobile.

Cost of Camp Installation Decreased

In connection with the above figures it must be considered that the capacity of the survey party, especially on construction work, is increased 50 to 80% by the use of the automobile. The cost of camp installation and equipment is correspondingly decreased, fewer camps being required. At least one team is required for each large camp, but only incidentally for survey work. In the three-month period of Table II, there were only two days in which the weather prevented the car from running and on these days the men preferred to walk to the tunnel work rather than try to get through with a team.

The most unfavorable conditions for the automobile in survey work are those of transportation across undeveloped country. Such conditions were experienced when orders were received to rush certain advance location surveys. This was in the middle of winter, and it was necessary to carry on the work from such camps as were already established. Teams were out of the question, as even at the start 50% of the time would be consumed in going to and from work, and this percentage would increase until there was no working time. Three automobiles were used, and the work was pushed rapidly in spite of the adverse conditions. It was found that even under such circum-

stances the automobile is more advantageous and at least as economical as the team outfits.

TABLE I. COST OF AUTOMOBILE AND TEAM SERVICE ON SURVEY AND CONSTRUCTION WORK

	Months of Cost Record	Average Cost of Maintenance per Month	Character of Service
Automobiles:			
I	11	$25.50	95% supervision, 5% survey
"	9	28.20	60% supervision, 40% survey
II	9	19.75	85% supervision, 15% survey
I	1	10.69	100% supervision (220 miles)
Teams:			
Fort Laramie	16	$29.34	40% survey, 60% construction and general
Cherry Creek	8	30.12	70% survey, 30% general
London Flats	13	46.26	60% survey, 40% construction and general
Box Elder	4	36.60	90% survey, 10% general

TABLE II. OPERATING COST OF AUTOMOBILE G

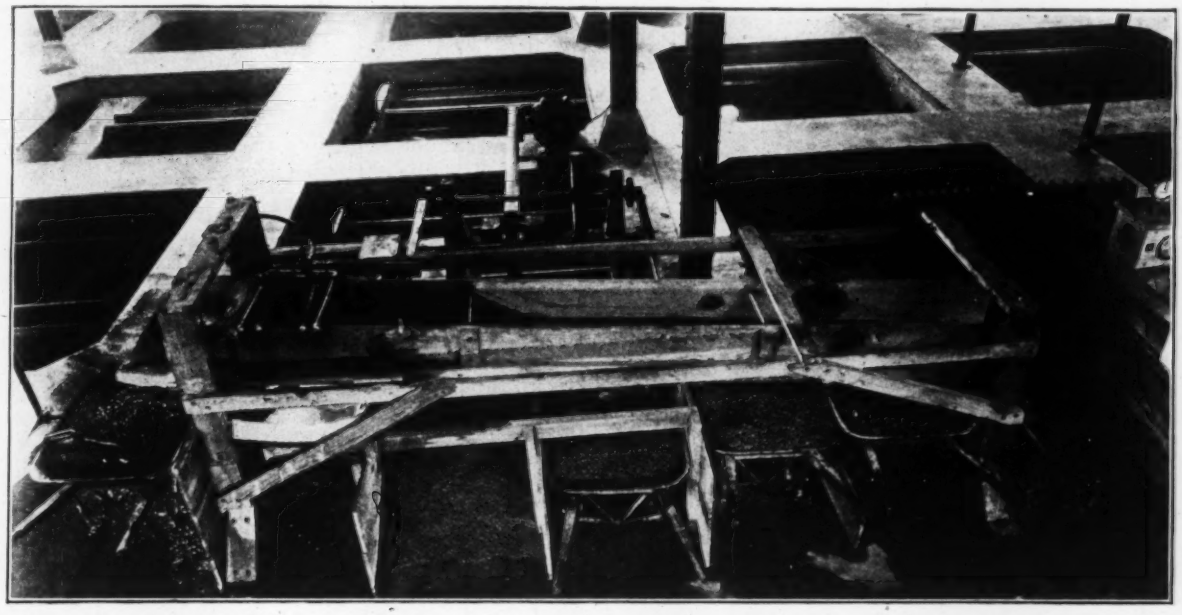
Month	Miles Run	Unit Cost per Mile: Gasoline	Lubrication	Repairs	Supplies	Total Unit Cost	Total Monthly Cost
Nov., 1916	466	3.1c.	0.5c.	1.0c.	4.2c.	8.8c.	$41.00
Dec., 1916	431	3.2c.	0.5c.	1.5c.	1.1c.	6.3c.	27.10
Jan., 1917	550	3.3c.	0.2c.	1.4c.	3.2c.	8.1c.	44.55
Average							$37.55

tion, the sheets still to be driven were sharpened to a chisel edge, by burning with the flame. The interlocks near the point were cut away on a slant, 4 to 6 in. back, and then the edge (3 to 10 in. wide) was burned to a bevel on the concave side of the sheeting, as sketched here. This expedient, devised by H. H. Fisher, Superintendent of Construction for the company, proved entirely successful.

Size Gravel in Home-Made Shaker

FOR resizing the gravel removed from the mechanical water filters at Grand Rapids, Mich., last winter, a home-made shaker operating on wet material was constructed at a cost of $37 for material by men regularly employed at the plant.

In 1914-15 the screens separating the gravel from the sand were removed, and the thickness of the gravel lay-



HOME-MADE MOTOR-DRIVEN FILTER GRAVEL SCREENING OUTFIT COST $37

Steel Sheeting Sharpened Makes Easier Driving

HARD driving and the presence of various obstructions in the river bottom complicated some deep sheet-pile cofferdam construction of the Louisville Gas and Electric Co. The intake and discharge tunnels for the company's power house extension, near the foot of N. 3rd St., are being constructed in open trench, within a single-wall cofferdam of steel sheeting driven to a maximum penetration of 65 ft. Arch-web sheeting of Lackawanna type, 14 in. wide, is used. About half the length of the cofferdam is in the open water, up to 25-ft. depth. Both the land and the water portions encountered numerous obstructions—boulders, buried logs, old boat hulls, a large brick-and-stone sewer, and the like. Even in clear soil (clay and fine sand) the driving often was very hard, and the tops of the piles became battered and distorted. To get easier penetrations was increased to a point where they alone would be stable against the upward force of the wash water. This increased the bulk of the gravel to be handled subsequent to overhauling threefold or fourfold. Formerly, it was necessary to spread out the gravel to dry on the filter gallery floors and later work it by hand through a series of screens 2 ft. square. The screens were shaken back and forth over saw-horses fastened parallel to one another, the whole material pile being worked over for each grade of gravel separated.

With the added volume this method became too laborious, so the motor-driven shaker screen pictured was built. It is made entirely of wood put together with bolts, the 2 x 14-ft. screen frame being supported by four hanger bolts. The feed end is raised 15 in. and made adjustable by turnbuckles in the hanger bolts. Horizontal pipe guides keep the screen box in alignment as the motor shakes the box sidewise through wooden

pulleys and crank disks at the rate of 130 to 140 r.p.m. The reduction was 1:2:5 or 1:3:5 and the power consumed by the 10-hp. motor did not exceed three horsepower.

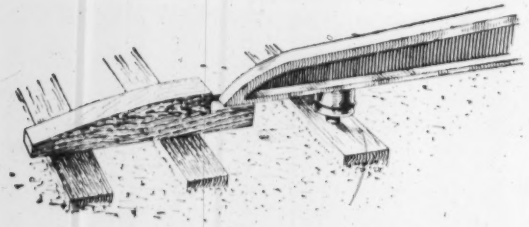
The sand and gravel mixture, shoveled into the feed end, passes first under the washing rig, consisting of four 1-in. perforated wash pipes supplied from a hose so as to provide the proper flexibility while the machine is in motion.

As the gravel passed down the screen box, it was found that the work was done in the first 6 in. of each screen. Five men are required to operate and keep the machine going at full speed, the gravel being taken from the filter, washed, graded and piled.

The machine was constructed by the men regularly employed at the plant, and the cost noted is exclusive of labor and cost of extra wiring for the spare motor used. The time saved over the former method is estimated at 85%, according to Walter A. Sperry, chief chemist, under whose direction the work was done.

Wood Block Guards Third-Rail End

TROUBLE is sometimes caused by faulty third-rail shoes getting below end approaches and thus breaking the insulators and tearing up the rail. The accompanying sketch shows how this is prevented on one railway property by a wooden block placed in front of a third-rail approach and securely nailed to the ties.



GUARD TO PREVENT THIRD-RAIL SHOES FROM GETTING UNDER THE RAIL

Sufficient clearance is left between the ends of the block and the rail to allow for the expansion of the latter. It has been found that no real harm results if the block accidentally comes in contact with the rail since the leakage is small even in wet weather.

Adopt Standard Screen Scale for Testing Sieves

AS A result of a two-year study of the question of a standard screen scale, a conference was called at the Bureau of Standards of representatives of various committees of the American Society for Testing Materials, the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Foundrymen's Association, the Mining and Metallurgical Society of America, the American Water-Works Association, the American Institute of Metals, the United States Geological Survey, the United States Bureau of Mines, the United States Office of Public Roads and Rural Engineering and the United States Bureau of Standards; there were present also representatives of a number of private firms engaged in industries in which sieves are used, and likewise representatives of the firms in this country manufacturing wire cloth and sieves.

The conference, after considering the various screen scales either proposed or now in use, adopted as a standard screen scale that given in the accompanying table, and recommends that it be adopted generally by scientific, technical and engineering societies and committees and by branches of national, state and municipal governments as a part of their specifications for materials and methods employed; also, that it be used by private firms who have need of standard sieves for carrying out their work.

The sieve having an opening of 1 mm. is the basic one, and the sieves above and below this in the series are related to it by using in general the square root of two, or 1.4142, or the fourth root of two, or 1.1892, as the ratio of the width of one opening to the next smaller opening. The first ratio is used for openings between 1 mm. and 8 mm., while the fourth root of two is used as the ratio of openings below 1 mm., to give more sieves in that part of the scale. The sieves of this series have been designated by the width of the opening in millimeters, as a 1.41-mm. sieve or a 0.36-mm. sieve.

The Bureau of Standards announces that it will test sieves of this series to determine whether they conform to specifications given below. This test will consist of the examination of the mesh of both the warp and shoot wires of the cloth to ascertain whether it comes within the allowed tolerance, and also measurements of the diameter of wires in each direction to determine the average diameter, and a measurement of any large openings to ascertain whether they exceed the limit given in the specifications. The sieve will be omitted to discover any imperfections that may seriously affect its value.

A fee of $2 per sieve will be charged for the test of a singly submitted sieve. For from two to nine sieves submitted at one time, the fee will be $1.50 per sieve, and for lots of ten or more the fee will be $1 per sieve. Only half of the above fees will be charged for such sieves as may be rejected for exceeding the tolerances of mesh, in which case the wire diameter will not be measured.

BASIC SIEVE OPENING IS 1 MM.

Sieve	Opening	Mesh	Wire Diam.	Ratio Wire Diam. to Opening	Tolerances Mesh	Tolerances Diam.
8-mm	8 00	1.0	2.00	0.25	±0.01	±0.08
5.66-mm	5.66	1.4	1.48	0.26	±0.01	±0.08
4-mm	4 00	2.0	1.00	0.25	±0.02	±0.05
2.83-mm	2.83	2.75	0.81	0.29	±0.02	±0.05
2-mm	2 00	3.9	0.56	0.28	±0.04	±0.05
1.41-mm	1 41	5.0	0.59	0.42	±0.08	±0.025
1-mm	1 00	7.0	0.43	0.43	±0.15	±0.020
0.85-mm	0.85	8.0	0.40	0.47	±0.2	±0.015
0.71-mm	0.71	9.0	0.40	0.56	±0.3	±0.012
0.59-mm	0.59	10.0	0.41	0.69	±0.4	±0.012
0.5-mm	0.50	12.0	0.33	0.66	±0.4	±0.012
0.42-mm	0.42	14.0	0.29	0.69	±0.6	±0.010
0.36-mm	0.36	16.0	0.26	0.72	±0.6	±0.010
0.29-mm	0.29	20.0	0.21	0.72	±0.8	±0.010
0.25-mm	0.25	23.0	0.185	0.74	±1.0	±0.008
0.21-mm	0.21	27.0	0.16	0.76	±1.0	±0.008
0.17-mm	0.17	31.0	0.15	0.88	±1.0	±0.008
0.14-mm	0.14	39.0	0.116	0.83	±1.0	±0.008
0.125-mm	0.125	47.0	0.089	0.71	±1.5	±0.008
0.105-mm	0.105	59.0	0.064	0.61	±2.0	±0.008
0.088-mm	0.088	67.0	0.061	0.69	±2.5	±0.005
0.074-mm	0.074	79.0	0.053	0.72	±3.0	±0.005
0.062-mm	0.062	98.0	0.040	0.65	±3.5	±0.005
0.052-mm	0.052	110.0	0.039	0.72	±4.0	±0.004
0.044-mm	0.044	127.0	0.035	0.80	±5.0	±0.004

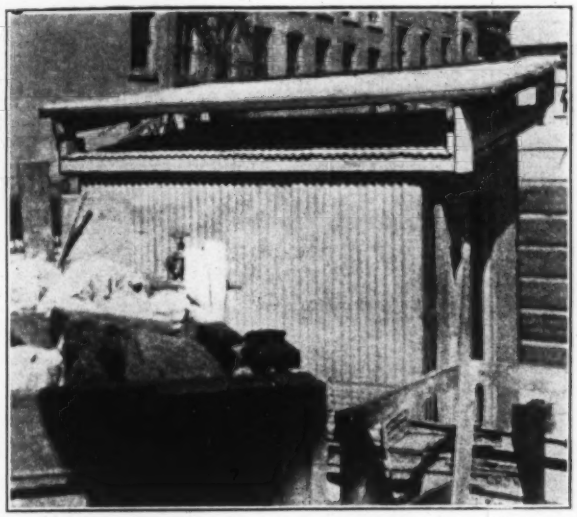
HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Wood Roof Above Iron Reduces Temperature of Corrugated Office

By Frederick B. Spencer
Engineer In Charge, Smith, Hauser & MacIsaac, Inc., New York City

PORTABLE houses of corrugated sheet metal are prone to get hot under a summer sun. In the one shown in the photograph this tendency is greatly reduced by the construction of a wooden roof 12 in. above the steel one. The construction, which is said to be common in India, keeps the sun off the metal and also provides a circulation of air above the lower roof. The



WOOD TOP ROOF KEEPS BUILDING COOL

second roof consists merely of 1-in. rough boards and is not water-tight.

The building shown is in use by Smith, Hauser & MacIsaac, Inc., in constructing a 20-story office building at the corner of John and William Sts., in New York City.

Concrete Road Laid in Freezing Weather at Slight Extra Cost

By F. E. Semon
City Engineer, Port Angeles, Wash.

BY REPLACING wet and frozen material in the subgrade with dry sand and gravel and covering the finished work where necessary with canvas and sand, the writer was able to complete in a satisfactory manner last winter a concrete road under construction by the city, which the taxpayers were anxious to have the use of during muddy winter weather. While the work was in progress, the thermometer often went to 26 deg. Fahrenheit.

The contract, awarded by the City Council in September, 1916, called for the completion within five months of 13,000 sq.yd. of concrete pavement 6 in. thick and 14 ft. wide. The writer took charge of the work during the first week in October, by which time the contractor had partly completed the grading and almost finished the drainage system. The pavement, laid in one course, was to be constructed under specifications recommended by the Cement Manufacturers' Association. The first paving was laid about Oct. 21, but from the first to the middle of November, rain practically suspended the work. Favorable weather succeeded, during which concreting was continued until December, when a cold spell, during which the thermometer went 6 deg. below freezing every night, occurred. Although the contractor was anxious to proceed, the writer did not think the safeguards that he proposed to supply for his contract price were sufficient and suspended the work.

2000 Yards Laid in January

However, a demand arose on the part of property owners to have the pavement finished so that those using the road would not be compelled to travel in a mud lane all winter, and on this account the city administration was willing to take some risk in putting the work through. The contractor was accordingly notified that the city would pay for extra work necessary to put the subgrade in condition and provide for extra covering required to protect the concrete from frost and cold. Proceeding on this basis, 2000 sq.yd. of concrete were laid during January, when the thermometer ranged from 25 deg. F. during the night to 44 deg. in daytime. All frozen ground was picked up and scaled off, the subgrade being backfilled with sand and gravel from the sea beach. Only enough subgrade was prepared at a time in this way for one day's run. The gravel used was broken up, if frozen into chunks, and all ice removed. Especial attention was paid to keeping water from the subgrade. Where necessary, it was drained into holes outside the curb and dipped out.

Since the subgrade was in a cut of 1 to 2 ft., the soil, a sandy loam, was easily turned into mud. To make certain of securing uniform bearing consistency and at the same time not to relax watch on the mixing of concrete, two inspectors were employed, one of whom gave his entire attention to the mixer. The contractor's men also maintained a close watch to see that no frozen material reached the mixer. Concreting was stopped early each day and the entire crew employed in covering the work.

Spread Canvas Before Concrete Set

Some trouble was experienced at first because the cool weather retarded the setting of the concrete so that the usual method of finishing could not be employed. This difficulty was overcome by using the "quaking" method. The fresh concrete was first "quaked" on the surface with a wood float attached to a long handle. If any wet spots appeared after the concrete had stood for a short while, they were removed by applying dry-mixed

sand and cement, patting down the spot until the whole mass was of the same consistency and floating it off evenly. This method proved very satisfactory. As soon as the spots had been removed in this way, the slab would be covered with a canvas for protection. Some of the slabs poured during the forenoon would usually be hard enough to be covered with fine beach sand.

Should the temperature seem likely to go below 26 deg., the canvas on the other slabs would also be carefully spread over with a thin coat of sand. This was leveled so that no depressions would be made in the green concrete. During the next day, should the weather be favorable, the canvas would be removed and the remainder of the previous day's work covered with fine sand. This sand was always kept damp and during the coolest nights the frost did not crust it to a greater depth than ¼ in.

The pavement was not opened to traffic for 30 days. When spring came and it was possible to compare the concrete placed in this way with that completed early in the fall under favorable conditions, there was no difference apparent, except in the finish. Those slabs on which canvas had been placed before the concrete was quite set are slightly ridged and present a mottled appearance. The method of finishing, however, appears to have benefited the slab.

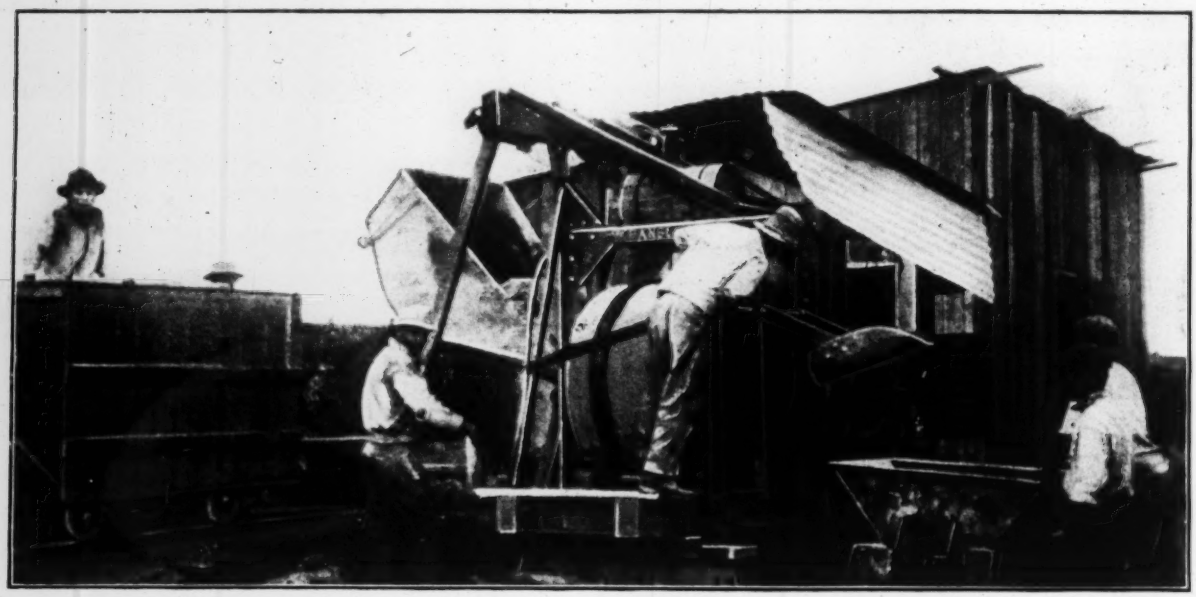
As to the cost of preparing the subgrade and applying the covering, the beach sand was delivered on the work for $1 per yd., and the preparation of the base cost about 6c. per sq.yd. It was not always necessary to replace the entire surface with gravel. In one instance the base was thawed with a steam hose from the mixer. In a few spots the ground was not completely replaced or thawed before placing concrete, but no harmful results have been observed since.

The experience on this road indicates that, if circumstances demand it, concrete pavement can be laid at small extra cost in frosty weather.

Three-Batch Measuring Cars Supply Mixer from Gondolas

By J. C. Foss, Jr.
Civil Engineer, Hilo, Hawaii, T. H.

EIGHT of the cars shown in the photograph were used recently for supplying a concrete mixer from railway cars in such a way as to keep the unloading gang busy, even when concreting was interrupted. Each car holds three complete charges for the mixer, there being six compartments, three for sand and three for stone. As shown in the photograph, a sand and a stone compartment are dumped together into the loading hopper of the mixer, while the cement, brought up on a platform car, is handled separately. The mixer can be operated to capacity, as there is less delay for switching with each car containing material for three successive charges. By having eight of these cars, sufficient capacity was provided to keep the unloading crew busy shoveling out of the railway cars long enough to cover any short delay at the mixer without having to throw material on the ground.



MEASURING CARS HOLD THREE BATCHES, REDUCING SWITCHING, AND EIGHT OF THEM FURNISH RESERVOIR THAT PREVENTS DELAYS IN UNLOADING

The track on which these cars were operated was 20-in. gage. The car frames and bodies were of wood, the trip doors to the compartments being hinged at the top.

Good Roads Reduce Horse Population

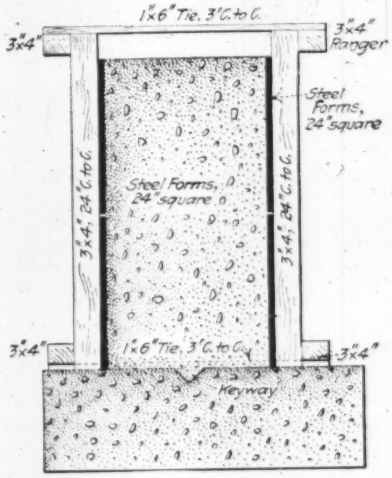
Despite the growth in population and increased areas under cultivation, the horse population of Los Angeles County is now less than one-half as much as in 1900. The automobiles and motor trucks have increased from 6 to 79,146. The 47,000 horses in the county in 1900 were valued at $5,000,000. In 1910 the drop in number was to 31,000, and in the ensuing six years to 20,000. The present automobile valuation is nearly $100,000,000. Excellent road conditions are considered largely responsible for the above figures.

Ladder Clamps Save Time on Concrete Forms for Low Wall

By J. G. Grossman
Fort Edwards, N. Y.

An easily erected and removed wall form that has been found very efficient by the writer is made by supporting Blaw form plates in the manner shown in the sketch. The form can also be made entirely of wood.

After the footing pad was concreted, two long 3 x 4-in. strips were fastened together by spiking 1 x 6-in. ties to them, like the rounds of a ladder. The whole thing was turned upside down and spiked in place to the concrete below, after which the 3 x 4-in. studs shown were erected with the 2-ft. square form plates inside them. These studs were held in place by a second ladder made just like the first one and slipped over the top.



FORM DOES NOT NEED WIRING, AND CAN BE REMOVED QUICKLY

In order to strike the form, it was only necessary to remove the top ladder, loosen the studs and take them and the plates out. Only enough pins are used in the steel plates to keep them in place during erection. No wiring is necessary with this form.

Lengthwise Rollers Under Piledriver Made Room on Street

The round piles for sheeting the excavations for the subway approaches to the Detroit-Superior bridge in Cleveland were driven by two machines whose rollers, instead of being at right angles to the long axis of the bed, were parallel to it. As the piles were all driven near the curb, the usual long cross-rollers could not have been employed without blocking the sidewalk or sticking out into the street. For the same reason, the long axis of the driver was parallel to the row of piles being driven, and little sidewise motion was required. Sliding a piledriver on top of rollers is somewhat speedier than rolling it, as it requires a less complicated hitch with the pile line and no effort on the part of the crew.

With these considerations in view, the roller saddles on these machines were turned around and the rolls, made of 10-in. pipe, placed under the machine lengthwise. This arrangement, shown in the photograph, also saved a little time by simplifying the blocking required for moving the machines. At the time work started, it was not possible to get any 10-in. pipe in Cleveland, and

SLIDING PREFERRED TO ROLLING IN MOVING TRACK

C. S. Smith, in charge of the work for the Bates & Rogers Construction Co., the contractor, was obliged to content himself with making rolls of short lengths which were on hand. These lengths are spliced with 4-ft. wood plugs. With these rolls, in moving backward it was possible to take off a piece of pipe in front of the driver and put it on again behind. However, this took more time than jerking the rolls through with the pile line, and the latter method was always used where possible.

Deficit Last Year for Government-Owned Canadian Railways

A net deficit of $1,179,867 resulted from the operation of the Canadian Government railways during the year ended Mar. 31, according to the annual statement of Frank Cochrane, Minister of Railways and Canals. The gross earnings were $23,465,565. The Government mileage was 4063. The figures compare with net earnings of $576,806 for the previous year, on gross earnings of $18,373,867. They do not, of course, take into account the fixed charges or the taxes for which private companies would be liable, nor do they cover interest on the investment. The Intercolonial Ry., with 1562 miles and gross earnings of $16,902,290, had net earnings of $1,137,713, which sum, it is stated, will be absorbed by the equipment-renewal account. The National Transcontinental Ry., with 2009 miles, suffered a net deficit of $1,966,626 on $5,916,550 gross earnings, as compared with a deficit of $652,141 on $3,758,387 gross earnings for the previous year.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELD

Railroads Lose Plea for Higher Freight Rates

Commerce Board Sees No Emergency in 1916-17 Figures—Allows Eastern Roads Class Increases

The 15% advance in freight rates sought by railroads, to take effect the first of this month, has been denied them by the Interstate Commerce Commission. By a decision rendered June 29, the commission disallows any general percentage increase, concluding that the actual figures for the ten months begun July 1, 1916, show no condition of emergency, so far as the Western and Southern roads are concerned, sufficient to justify any general increase. The condition with the Eastern roads is held to be somewhat different, and these roads are permitted to make a general increase in class rates, equivalent, it is estimated, to 8 or 10 per cent.

The report contains an analysis of the earnings and expenses of the carriers for the ten months ended Apr. 30. Figures are given indicating net income on property investment of 6.64, 5.26 and 5.43% for the Eastern, Southern and Western districts respectively during 1916, and 4.89, 6.45 and 6.21% respectively, estimated, for the first four months of 1917. The commission concedes that there have been large increases in the costs of supplies, but points to a wide divergence between carriers and protestants, and between the carriers themselves, as the amount of these increases in percentages. The commission holds, that "the aggregate of the increased expenses thus imposed cannot be predicted with any satisfactory degree of certainty," and concludes that "we prefer to confine our forecast to the basis of actual experience for the ten months from July 1, 1916." Through the medium of the carriers' monthly reports the commission expects to be able to meet any changed conditions.

Four members of the commission, Messrs. Hall, Clark, Daniels and Harlan, rendered the decision. Commissioner Harlan, however, concurred only to secure affirmative results. In a separate report he decries the month-to-month statistical view of the matter, and declares in favor of full relief for the carriers. Commissioner Meyer is opposed to any increase to the Eastern roads, while Commissioner McChord thinks the issue is one of governmental policy, for Congress to determine, rather than one of the reasonableness of rates. The seventh member of the commission was the late Judson C. Clements.

Earth-Dam Failure in Utah Causes $2,000,000 Loss

Makeshift Spillway Never Came Into Use—Concrete Heart-Wall Retarded Flood—Railway Track and Bridges Washed Out

BY TELEGRAPH FROM H. KLEINSCHMIDT
Consulting Engineer, Salt Lake City

The dam forming the Mammoth reservoir of the Price River Irrigation Co., six miles west of Scofield, Utah, failed June 24 and 25. The maximum flood crest, estimated at 20 ft., destroyed the Scofield branch of the Denver & Rio Grande R.R. from Hale to Scofield (six miles), and most of the main line of the same railroad from Colton to Price (25 miles), including 10 steel bridges. It is expected that the railroad will be out of service three weeks or more. The enforced shutting down of coal mines makes a shortage of coal that threatens the manufacturing industries of Utah. The direct property damage to the flood caused by the dam failure is estimated at $2,000,000 and will fall mostly on the railroad. Owing to the ample warning afforded by the slowness of the destruction of the dam, there was no loss of life except of one spectator, whose automobile backed into the flood.

The dam was located on Gooseberry Creek, 20 miles above its junction with Price River at Colton. It stored about 11,000 acre-feet of water to irrigate land southwest of Price.

DESIGN FOR 100-FT. HEIGHT

The dam was of earth, with a reinforced-concrete heart-wall. It was designed for a height of 100 ft., but construction was stopped at 70 ft., with a top width of 150 ft. The heart-wall was at the center of the dam, founded on bedrock. It was 2 ft. thick, buttressed on each side every 25 ft. and reinforced vertically with ½-in. rods 12 in. c. to c. The horizontal reinforcement was carried up for only 12 ft. from the base of the heart-wall.

In the fall of 1916, after the dam as described had been in use a few years, the heart-wall was raised 5 ft. The earth embankment on the upstream side of the heart-wall sloped upward in the upstream direction from a level 4 ft. below the top of the heart-wall for a horizontal distance of 80 ft., where it terminated in a small earth dike with a crest 3 ft. above the top of the heart-wall. On the downstream side of the core wall the top of the earth embankment was 10 ft. below the top of the heart-wall.

In place of an adequate spillway, there was a temporary wooden flume across the north end of the dam. This flume was 9½ ft. wide and 2½ ft. deep, with a 6½-ft. drop at the lower side of the heart-wall. The upper end of this flume ended in the north dike, without using walls or cutoff. Flashboards in the upper end of the flume held the water in the reservoir at an elevation 3 ft. below the crest of the earth dike, or just on a level with the top of the heart-wall.

FIRST BREAK NEAR FLUME

The break in the dam began between noon and 3 p.m., June 24, while the watchman was at dinner. Undoubtedly it started in the earth dike at the head of the flume. The depression between the dike and the heart-wall was nearly filled with water, the water mark on the wall, 9 in. below the top, corresponding with the high-water mark of the reservoir.

A section of the heart-wall 40 ft. long, near the center of the dam, broke out along the junction plane of the addition made last fall. The wall was probably weakened by expansion cracks. The heart-wall retarded the washout, so the final collapse came 30 hours after the first break.

The reservoir outlet tower rising from the foot of the upstream slope was unfinished. The top of the concrete was below the level of the water in the reservoir, but wooden forms projecting above the water surface allowed only a small flow into the tower. The only access to the tower was by raft. When help arrived two hours after the initial break, the outlet gates in the tower could not be opened.

The tower concrete outlet culvert beneath the dam and 100 ft. of heart-wall at the south end of the dam are intact, but the remainder of the dam is practically wrecked for its entire length of about 500 feet.

The failure was due to holding water too close to the top of the small dike on the upper half of the embankment and to the inadequate protection of the upper end of the flume designed to serve as a spillway. No water flowed through the spillway before the break.

The examination on which the foregoing report is based was made in company with George F. McGonagle, state engineer of Utah.

[The dam and the irrigation project of which it was a part were described in the *Engineering Record* for Dec. 28, 1912, p. 724.—Editor.]

Details of Contracts for Cantonments Given

Simplicity of Agreement Should Secure Greatest Speed at Lowest Cost

The urgency of quick construction is indicated in an early paragraph of the contract for the construction of the National Army Cantonments wherein the contractor agrees to "do all things necessary for the construction and completion of the work." The Government's interests are safeguarded by a clause permitting its representatives to terminate the contract at will, but it is not expected that there will be any serious differences of opinion between the Government and any of the firms chosen for the work, who are given every possible help and incentive to provide the best homes for the new troops which it is practicable to give in the time available for the work.

REIMBURSEMENTS PROMISED

The Government promises to reimburse the contractor on the following items for which he makes an outlay:

1. All labor, materials and machinery necessary for the work. No departure from the standard rate of wages in the locality may be made without the consent of the Government's representatives.
2. All subcontracts.
3. Rental for construction equipment hired or owned by the contractor at rates fixed in detail on the contract. The rates may be judged from the daily rental of $5 permitted for the use of an automobile.
4. Transporting, setting up, and dismantling such equipment.
5. Transportation of field forces engaged in the work.
6. Salaries of resident engineers, superintendents, timekeepers, foremen, or other men in the contractor's field office.
7. Buildings, field office supplies, equipment, commissary department, and hospital expenses required during construction.
8. Insurance and bonding expenses, uninsured losses and expenses incidental to the work and approved by the Government's representatives.
9. Fees, deposits, royalties and similar necessary expenses.
10. Transportation, traveling and hotel expenses of contractor's employees actually incurred in the work.

HAS SOUGHT FLEXIBILITY

In order that all low rates accessible to the Government in the matter of materials and other items of expenditures may be utilized, the Government may pay any or all freight charges incurred in obtaining material and machinery. Through this arrangement, advantage could be taken of the specially low rates which the Government obtains from land-grant railroads.

Freight charges on hauls over 500 miles must be specially approved in every case by the Government's representative. The title to all work in progress or completed is in the United States and all materials and machinery for which the contractor is to be paid, under clause 1 of the preceding classification of expenses, belong to the United States as soon as accepted in writing by its representative.

PROFIT LIMITED TO $250,000

The contractor is to furnish a bond for $250,000. His profit and overhead expenses must come from an additional payment made by the Government and amounting to 6 per cent. of his expenses as enumerated above in cases where the work costs over $3,500,000 and running up to 10 per cent. if the total is under $100,000. The total amount of this percentage payment will in no case be allowed to run over $250,000, no matter how high the total cost of the work may be.

The value of any construction equipment furnished by the Government is not included as a part of the cost of the work when determining the contractor's percentage, nor any uninsured fire or liability losses which the Government may pay to him under clause 8, nor any payments by the Government for freight, nor any of his overhead expenses. The contract fixes his compensation on the cost of work done by subcontract at 5 per cent. and on the reconstruction of damaged work not over 7 per cent.

PROVISION FOR MONTHLY PAYMENTS

Provision is made for monthly payments for actual expenses approved by the Government's representatives who have access at all times to the accounts kept by the contractor. This puts the minimum strain on the contractor's financial resources while giving the Government a complete check on the accuracy and propriety of every item before payment is made on it.

Steel Market More Uncertain from Now On

Situation Regarding Price Fixed by Defense Board for Coal Has Deep Significance for Construction Field

According to the statement of the U. S. Chamber of Commerce, within a short time no steel will be available for construction work not necessary for national existence. The prices during the past month have shown more and more erratic tendencies, and many more quotations must be regarded as merely nominal. It will be useless, in all probability, to contract for future deliveries of steel products, as unless intended for industries or facilities necessary to the war, the contracts will probably have to be cancelled. Even in May steadily rising prices, increasing transportation difficulties and the seriousness of the labor situation had resulted in a heavy falling off in building permits, not only from the active month of May, 1916, but from the preceding months of this year. With the announcement, therefore, that steel for ordinary building construction is likely to be exceedingly scarce, the general construction of office buildings and similar structures will hardly be expected to increase.

With other building materials, however, the situation is less serious. By the first of June the special railroad board, aided by normal slackening of commercial demand, had succeeded in reducing the indicated car shortage more than 30% to 105,126 cars. Although the consumption of cement is increasing and the demand will undoubtedly continue to grow because of the difficulty of securing steel for ordinary construction, some factors, of which the improving car situation is one and the recent reduction announced in the price of coal is another, indicate that the cost of producing and marketing cement may diminish. If the price agreed on by the council of national defense is allowed to stand, the cost of producing brick, tile and other construction materials as well as cement in which fuel is a considerable item of expense, will undoubtedly be reduced. If, on the other hand, the views expressed by some cabinet members, that the Government should squeeze the coal operators down to the lowest possible price, with the presumption that the deficit must be made up in higher prices to the general public, should prevail, the price of coal to these industries supplying construction materials will probably be forced to dangerous levels, and further damage done by increasing the cost of work. The injustice and probable grave consequences of levying this type of tax, an inevitable corollary to the price-fixing proposition as advanced in certain quarters, was discussed editorially last week in connection with efforts directed to force the price of steel on Government orders to an arbitrary level, which those most conversant with conditions believed to be below the cost of production.

General business, as measured by bank clearings, foreign trade and other indications, continues even more active than last year. While interest rates will, of course, tend to increase from now on, the situation should favor developing all the engineering construction that the labor and material supply can take care of. The recent decision of the Interstate Commerce Commission denying the railroads a general 15% increase in freight will doubtless have a depressing effect on the railroads, though the granting of class increases and the disposition of the commission to reconsider the subject at any time the financial position of the roads should be adversely affected, affords some encouragement. While no railroad construction at present prices is likely to develop, except in the case of urgently needed work, there may be a good many improvements which will

fall in this class in the way of extra track and terminal facilities.

From present indications, the increasing demand for freight highways and for adequate roads to assist in crop transportation is well recognized, and states and other governmental bodies apparently intend to push road construction to the full extent of the funds available. There is plenty of money in the country to finance the war without hampering needed road and municipal work, and it is to be hoped that the coming Government loans will be taken, even more extensively than the present one, out of the earnings of the public, leaving the banks and long-established financial agencies relatively free to furnish the money needed by states, municipalities and various industrial corporations.

Permit Maximum Diversion of Niagara Falls Water

The Senate and the House of Representatives have agreed to the conference report on the bill permitting the present maximum diversion of 20,000 ft. of water on the American side of Niagara Falls and it was rushed to the White House and signed late Saturday by President Wilson so that it might become law before midnight of June 30, the date when the old authorization expired.

The measure carries with it an appropriation of $25,000 for expenses of an investigation to be made by the War Department.

Covers a Period of One Year

Those in charge of the measure explained to the President that but for the legislation just enacted, which is for the period of one year, 50,000 hp. would have been cut off on the American side of the Falls. It was pointed out in behalf of the power interests that although 20,000 cu.ft. of water per second has been, and is now again permitted to be diverted, only 19,000 cu.ft. has been used.

It is expected that the War Department will make its investigation at once, probably through the officer of General Black, Chief of Engineers. The Secretary of War is to send the surveys made to Congress "as soon as possible," and he is to continue to issue temporary permits until July 1, 1918, as authorized by Congress last January.

St. Louis Hesitates on Paving

The City of St. Louis, Mo., is proceeding cautiously with its paving program. Much of the work, aside from main thoroughfares, is being held back. In some cases a referendum of the property owners is being taken to learn their views on the continuance of the work in the face of rising prices. Brick pavement on a 6-in. concrete base, which cost $1.80 per sq.yd. in 1915, is now costing the city $2.35. Sheet asphalt has increased in cost from $1.85 to $2.30 per square yard.

Philadelphia Ready To Build First Sewage-Works Unit

Calls for Bids on Northeast Treatment Plant, Comprising Thirty-Two Two-Story Tanks

The publication in this issue of an advertisement inviting proposals for the construction of the Northeast sewage-treatment works at Philadelphia marks an important step in the carrying out of a comprehensive plan for the collection, treatment and disposal of sewage which was recommended in the report made by the Bureau of Surveys early in 1915. The report advised that the first available funds should be expended in the acquisition of land for the sites of works and for an intercepting sewer system and treatment works for the drainage area of Frankford Creek, which is now grossly polluted and enters the Delaware River about 4¼ miles below Torresdale, where the large water filters are located.

Citizens Vote For Loan Bills

In the summer of 1915 the City Councils authorized and appropriated $500,000 toward the construction of the Frankford Creek intercepting sewer, of which 2.6 miles are now under contract and partly completed. At an election last summer, the citizens of Philadelphia voted in favor of loan bills aggregating about $115,000,000, which included $3,200,000 toward the sewage-disposal project. Under that authority land was acquired for the sites of the Northeast and the Southwest sewage-treatment works, contracts were made for a large grit chamber, and the Northeast works will now be built.

These works will consist of 32 horizontal-flow, rectangular two-story sedimentation tanks and 80 sludge-drying beds, together with grading and such appurtenant works as influent and effluent sewers.

Much Metal Eliminated

As far as was practical, the contract drawings show that metalwork has been omitted, such as the sludge pipes, railings, metal gates, weirs and similar parts. Where metal parts such as stop plank grooves must be embedded in the concrete, they are included in this contract.

Contract No. 20 will comprise principally excavation of the site and construction of the reinforced-concrete tanks and sewers and the sludge beds. It appears to be the intent of the officials to proceed with the construction by beginning work which contractors can handle easiest under present conditions and later to invite proposals for installing the necessary metalwork to complete the works.

Scrap Iron Brings $60 Ton

The City of Cleveland received a record-breaking price for scrap iron June 11. Twelve tons, sold by the Water Department, brought $60 a ton.

Springfield Trade Show Is Well Attended

More Than 200 Manufacturers, Export Interests, Selling Agencies and Banks Were Represented

For the eight days ended June 30 the well-equipped exhibition buildings of the Eastern States Exposition of Springfield, Mass., housed an industrial display. More than 200 manufacturers, selling agencies, banks and export interests were represented at the first annual Industrial Exposition and Export Conference.

The export conference opened June 25 with the "Paper Day" sessions; it included 11 other group gatherings. The list of topics will suggest the wide range of industrial activities covered: "Paper," "Textiles," "Export Financing," "Leather and Rubber Goods," "Reaching Foreign Customers," "Latin America," "Metals and Machinery," "Practical Exporting," "Office Appliances," "Transportation and Shipping," "Russia and the Far East," "Chemicals and Drugs."

Three hundred manufacturers and executives attended the opening session, and at no subsequent gathering was the attendance below 100, except at two of the morning meetings. "Metal Day" turned out the largest number of conference visitors.

Speaking to the subject of "Metal Fittings in Overseas Markets," A. W. Gilbert, president of the Chapman Valve Manufacturing Co., said: "We are receiving orders from France at this time. This we attribute to present war conditions in Europe, but investigations made since the war began convinces us that with an American owned merchant marine and under conditions of peace and with banking facilities friendly to American manufacturers, we can compete with any prices that we are aware of at this time and which prevailed previous to war conditions and where shipments had to be made into other countries by our foreign competitors." He instanced several occasions in which foreign competition had been successfully met

Postpone Date of Bidding on 18-Mile Shandaken Tunnel

The Board of Water Supply of the City of New York has postponed from July 17 to Sept. 11, the date for the opening of bids on the Shandaken Tunnel, the 18-mile bore which will connect the Schoharie watershed with the Esopus, which is now supplying a large quantity of water to New York through the Catskill aqueduct. This is one of the biggest of the Catskill contracts and while no definite estimate of the cost can be given now, guesses by those familiar with the work have been above the $10,000,000 mark. The postponement will allow contractors who have undertaken rush work for the Government to adjust their organizations to the new conditions before bidding on new work.

Contracts for 176 Ships and Hulls Have Been Let

General Goethals Summarizes Work of Emergency Fleet Corporation Up to June 26

The United States Shipping Board, Emergency Fleet Corporation, through its General Manager, Major. Gen. George W. Goethals, announces that the following contracts for the construction of merchant vessels have been executed:

Merrill-Stevens Company, Jacksonville, Fla., 12 wooden cargo-carrying steamers complete, 4 cargo-carrying all steel ships complete.

Los Angeles Shipbuilding & Dry Dock Company, P. O. Box 68, Long Beach, Calif. 8 cargo-carrying all steel ships complete.

G. M. Standifer Construction Corporation, Northwestern Bank Bldg., Portland, Oregon. 10 wooden cargo-carrying steamers complete.

Peninsular Shipbuilding Company, Portland, Oregon. 4 wooden cargo vessels complete.

Sloan Shipyards Corporation, Seattle, Wash. 16 wooden cargo-carrying steamers complete; first steamer to be delivered Jan. 31, 1918; two in February, 1918; four in March, 1918; two in April, 1918; two in May, 1918; two in June, 1918; two in July, 1918.

Grays Harbor Motor Ship Corporation, Aberdeen, Wash. 4 wooden hulls. First hull to be delivered Jan. 15, 1918; second Feb. 15, 1918; third March 15, 1918; fourth April 15, 1918.

Coast Shipbuilding Company, Portland, Oregon. 4 wooden hulls. First hull to be delivered Jan. 1, 1918; second March 1, 1918; third May 1, 1918; fourth July 1, 1918.

Edward F. Terry & Henry L. Brittian, 60 Broadway, New York City. Works, Moss Point, Mississippi. 20 composite cargo carrying steamers complete. First steamer to be delivered Feb. 1, 1918, and the remaining 19 within next ten months.

Skinner & Eddy Corporation, Seattle, Washington. 6 steel cargo carrying steamers complete. First two steamers to be delivered within five months from date of arrival of keel plates, and of the remaining number of steamers the building of the second two steamers shall be commenced immediately after the completion of the first two steamers and shall be delivered within five months after the laying of the keels, and the building of the remaining two steamers shall be commenced immediately after the completion of the second two steamers and shall be delivered within five months after the laying of the keels.

Sanderson & Porter, 52 William Street, New York City. Works: Willapa Harbor. 10 wooden hulls; first hull to be delivered on April 1, 1918, and one hull every fifteen days thereafter, ending Aug. 30, 1918.

The Maryland Ship Building Company, Lexington Bldg., Baltimore, Md. Works: Sollars Point, Maryland. 6 wooden hulls; first hull to be delivered April 30, 1918, and one hull to be delivered on the last day of each succeeding month, ending Sept. 30, 1918.

Seattle Construction and Dry Dock Co., Seattle, Washington. 10 steel cargo-carrying steamers complete; first and second steamers to be delivered in June 1918; third in July, 1918; fourth and fifth in August, 1918; sixth in Sept. 1918; seventh and eighth in Oct. 1918; ninth in Nov. 1918; tenth in Dec. 1918.

The Foundation Company, Woolworth Building, New York City. Works: Newark, N. J. 10 wooden hulls. First hull to be delivered Mar. 1, 1918; the remaining hulls to be delivered one every 15 days thereafter, so that the last hull will be delivered on or before Aug. 15, 1918.

Groton Iron Works, 50 Broad Street, New York City. Works: Noank, Conn. 12 wooden hulls. First hull to be delivered five months after receipt of lumber for keels; remainder average of one hull every two weeks thereafter but all by Sept. 15, 1918.

Ship Construction and Trading Company, 50 Broadway, New York City. Works: Stonington, Conn. 2 wooden hulls. First hull to be delivered on or before February 12, 1918; second on or before Mar. 12, 1918.

Moore & Scott Iron Works, San Francisco, Calif. (works, Oakland, Calif.)—Ten complete steel cargo-carrying steamers. Deliveries: First and second in February, 1918; third, in March, 1918; fourth and fifth, in June, 1918; sixth, in August, 1918; seventh and eighth, in October, 1918; ninth and tenth, in November, 1918.

Portland Ship Ceiling Co., 130 Commercial Street, Portland, Me.—Four wooden hulls. Deliveries: Feb. 1, 1918; Mar. 15, 1918; May 1, 1918; June 15, 1918, respectively.

Universal Shipbuilding Co., 25 Broad Street, New York City (works, Houston Ship Canal, Harris County, Tex.)—Twelve wooden hulls. Deliveries: First and second, seven months after completion of the ways; third and fourth, eight months after completing ways; fifth and sixth, nine months after completing ways; seventh and eighth, 10 months after completing ways; ninth and tenth, 11 months after completing ways; eleventh and twelfth, 12 months after completing ways.

McBride & Law, Beaumont, Tex.—Four wooden hulls. Deliveries: First hull on or before Mar. 1, 1918; second hull on Apr. 1, 1918; third hull on May 1, 1918; fourth hull on June 1, 1918.

Newcomb Life Boat Co., Hampton, Va.—Four complete wooden cargo-carrying steamers. Deliveries: First steamer by Jan. 15, 1918; balance, one steamer every 60 days thereafter, so that last steamer will be delivered on or before July 16, 1918.

In addition to the foregoing contracts the following contract for the construction of marine engines is announced:

Ellicott Machine Corporation, Baltimore, Md.—Twelve vertical triple expansion marine engines, size

$$\frac{22 - 37\frac{1}{2} = 60}{42}$$

SUMMARY TO JUNE 26

Total number of contracts for ships and hulls executed	22
Total number of ships and hulls contracted for	176
Complete steel ships	38
Complete composite ships	32
Complete wooden ships	34
Total complete ships	104
Total wooden hulls	72
Total number of contracts for marine engines executed	1
Total number of marine engines contracted for	12

Take Jamestown Exposition Site for Naval Station

President Wilson has issued a proclamation taking over the old Jamestown Exposition site on Hampton Roads, about 440 acres, upon which is to be built, at a cost of $2,800,000, what will probably be the greatest of all the United States naval stations. The sum of $1,200,000 is for the ground, and the remainder, $1,600,000, will be used in developing the site.

The work will be begun at once. A great series of coast artillery batteries, electrically operated, will be constructed, as well as piers, store-houses, oil-fuel storage, training stations, etc. The Government, under the proclamation, takes over all the rights and properties on the site of railways, electric light, power, telephone, telegraph, cable, water and sewer companies. All owners of property or persons residing or doing business on the tract have been notified to vacate by Aug. 1. The property is placed in charge of the Secretary of the Navy, and Rear Admiral Harris, chief of the bureau of yards and docks, Paymaster General McGowan, in conjunction probably with General Weaver, chief of coast of artillery of the army, will undertake the work of developing the station as rapidly as possible.

Concrete Heart-Wall Saves Most of Earth Dam in Oregon

The concreted heart-wall of an earth dam near Baker, Ore., appears to have saved the dam from being completely washed out on June 28. A portion of the crest reported as 40 ft. long went out, lowering the level of Lake Killamaque 10 ft., shutting down the power plant of the Eastern Oregon Light and Power Co., which supplies Baker and Haines, destroying several buildings at Rock Creek, washing out or filling up irrigation ditches, drowning live stock, but causing no loss of human life. It is said that the water level at the time of the failure was considerably below former levels and that the dam may have been injured by ice last winter or perhaps dynamited maliciously. A local investigation is being made.

Municipal River Terminals Building in St. Paul

Shortage of Coal Last Winter Forces Action in Attempt To Revive River Traffic

St. Paul has begun the construction of municipal river terminal facilities for handling coal and iron ore under plans prepared by City Engineer O. Claussen. Fifty thousand dollars has been appropriated for the first unit and the plant will be ready to unload coal and reload barges with iron ore by August 10.

Arrangements have been made with the United States Government for a fleet of 24 steel barges of one thousand tons capacity each and the necessary towboats. Southern Illinois coal will be loaded at St. Louis by the Southern Coal, Coke & Mining Company and the returning barges with iron ore, brought into St. Paul over the Northern Pacific Railroad from the Cuyuna Range, for the Mississippi Valley Iron Company at St. Louis.

For several years St. Paul has talked of the revival of river traffic but no definite steps have been taken until the present time. The shortage of coal last winter and the present car shortage and general uncertainty in transportation matters excited a new interest in the possibilities of river transportation and resulted in the present definite arrangements for giving it a trial.

St. Louis Public Service Board Receives New City Plan

The City Plan Commission of St. Louis presented to the Board of Public Service on June 12 a report on the major street system of the city. The report points out the defects of the rectangular system which in some parts of the city divide traffic to such an extent that every street is a thoroughfare. It points out the favorable situation with respect to certain diagonal arteries now existing. It recommends the completion of the proceedings for widening Washington Avenue from Jefferson Avenue to Grand Avenue; of widening of Olive Street from Fourteenth Street to Channing Avenue, these two with Locust Street to give three main east and west thoroughfares.

DEFERRED PAYMENTS RECOMMENDED

The report recommends a revision of the plan for opening Twelfth Street as the connection to the southwestern system and recommends a plan for opening Twelfth Street to connect with the northwestern system. It also recommends a revision of procedure which would permit of deferred payments for benefits assessed on street openings of this kind and for improvement of the street so opened in order that the property may not be overburdened with taxes until it reached burdened with taxes until such a time as it may have reached the expected development.

Many Standard Parts in New Military Truck

A long step forward in interchangeability of motor-truck parts has been effected through conferences concerning the specifications for the desired 70,000 military trucks. Representatives of the Society of Automotive Engineers, Quartermaster General's office and War Department Transport Board studied the matter together. As a result of a two days' conference early in June of representatives of engineers, transmission and truck manufacturers with the Advisory Commission of the Council of National Defense, a decision was reached that the engines and transmissions to be used in many of the military trucks will be interchangeable. This action will not only facilitate the putting of the necessary number of trucks into service, but will decrease greatly the problems connected with the replacement of parts and the making of emergency repairs in the field.

Texas Has Good-Roads Convention

Highway development and reclamation were the keynotes of a joint meeting held at Mineral Wells, Tex., June 19 to 23, by the Texas Good-Roads Association, the Fort Worth and El Paso Highway Association, the Dallas and Texarkana Highway Association and the Texas Reclamation and Conservation Association. While most of the papers and addresses were of a promotional character, there were the following dealing more or less with technical matters: "Sand-Clay Road Construction," by George D. Marshall, of Forrest, Ark.; "Coöperation Between State Highway and County Engineers," by George A. Duren, state highway engineer of Texas; "Economy in Bridge Construction," by F. E. Hesse, of Dallas, Tex.; "The Kind of Gravel To Use in Building Roads," by R. J. Potts, of Waco, Tex., "Reclamation of Overflowed Lands," by C. S. Fowler, of San Antonio, Tex., and "Roads I Have Built," by J. D. Meriwether, engineer of the Fort Worth and El Paso Highway. Prospects for state highway work in Texas are considered to be promising.

Appointments for Connecticut Board of Health Made

The membership of the new Connecticut State Board of Health as recently announced by Governor Holcomb is as follows:

John T. Black, M. D., who was secretary of the old board, to be Commissioner of Health and Chairman of the Public Health Commission; J. Frederick Jackson, C. E., New Haven, reappointed to serve until 1919; E. K. Root, M. D., Hartford, to serve until 1923; Lewis Sperry, Esq., Hartford, to serve until 1923; W. H. Brown, M. D., Bridgeport, to serve until 1921; C. E. A. Winslow, M. S., New Haven, to serve until 1921; and James A. Newlands, B. S., Hartford, to serve until 1919.

PERSONAL NOTES

L. T. JESSUP, drainage engineer, Department of Agriculture, has been transferred from the Denver office to North Yakima, Wash., where he will have charge of drainage investigations on the United States Reclamation Service project, succeeding W. A. KELLY, who is in Wyoming on department investigation.

W. H. SCHWARTZ, former county engineer of Clarke County, Washington, has been appointed city engineer of Vancouver, Washington.

CLYDE MEYERS, of Pullman, Wash., was recently appointed city engineer of Pullman.

CHARLES F. D. HENRY, county engineer of Pacific County, Washington, has been appointed city engineer of South Bend.

BAMLET KENT has retired from Federal service after 22 years with the United States Engineer Office to become district manager in Detroit for the Duluth-Superior Dredging Company.

M. M. MOORE, formerly with the machine-tool department of Gaston, Williams & Wigmore, Inc., New York, is now associated with the sales department of John W. Thorne & Co., Inc., with headquarters at 165 Broadway, New York.

G. C. BUSH has left the Buick Motor Co., where he was employed as plant engineer in charge of maintenance, construction and power transmission, and is at present with the American Zinc Co. of Tennessee as engineer of maintenance and construction, assisting R. L. BAGBY, chief engineer.

G. S. VAN NATTA is at present with Hess & Skinner, of Dallas, Texas, as resident engineer on highway construction for Donley County. Hess & Skinner are consulting engineers on the work, Mr. Van Natta acting as resident engineer in direct charge.

C. A. HOGENTOGLER has been granted a year's leave of absence from the faculty of the University of Iowa and is engineer and supervisor for the borough of Columbia, Penn., on roadwork. Mr. Hogentogler has been at various times employed by Ritter-Conley Manufacturing Co. (Pittsburgh), Barber & Ross (Washington, D. C.), Pennsylvania Steel Co. (Steelton, Penn.). and as assistant in civil engineering, Pennsylvania State College.

PROF. GEORGE C. WHIPPLE, head of the sanitary engineering department at Harvard University and member of the firm of Hazen, Whipple & Fuller, of New York City, left for Russia last week as a member of the American Red Cross Mission. "It is going to be the most interesting work

I have ever undertaken," said Prof. Whipple on the eve of his departure.

S. T. WELLMAN, upon whom the Cleveland Engineering Society conferred the honor of honorary membership, is best known as the inventor of the openhearth charging machine and for his adaptation of the electromagnet to the handling of pig iron and scrap steel. This work was done during his connection with the Otis Steel Works in Cleveland, with which concern he became connected in 1873. He also has to his credit the construction of the first openhearth furnace which proved to be a commercial success in the United States. Previous to this time he had been connected with Singer, Nimick & Co., for whom he built crucible steel melting furnaces, at later times doing similar work for the Chrome Steel Works in Brooklyn, N. Y. At various times he has been president of steel companies and engineering firms—at the present time being chairman of the Wellman, Seaver, Morgan Co. Mr. Wellman is a past president of the American Society of Mechanical Engineers and the Cleveland Engineering Society.

ALVAH HORTON SABIN, consulting chemist of the National Lead Co. and lecturer at New York University, was given the degree of Doctor of Science by Bowdoin College June 21. From 1876 to 1879 Professor Sabin was professor of chemistry at Ripon College, designing and erecting the laboratory and astronomical observatory. From 1880 to 1886 he was professor of chemistry at the University of Vermont, and was president and manager of the American Milk Sugar Co. from 1885 to 1886, designing and building factories and refineries for the manufacture of milk of sugar under a process developed by himself. Professor Sabin is author of "Technology of Paint and Varnish," a second edition of which has just been issued.

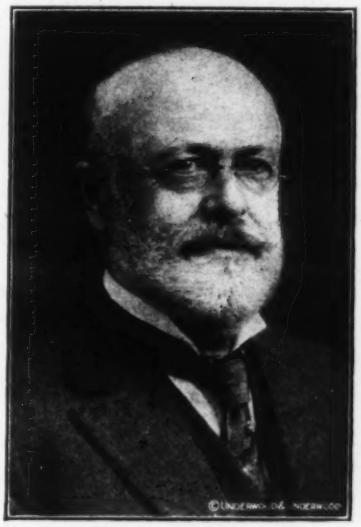
FRANK H. SIMMOND has resigned as safety engineer with the Travelers Insurance Co., to accept an appointment as junior engineer with the United States Reclamation Service, and is now located with the Fort Laramie unit of the North Platte River project, with headquarters at Kiawa Camp, Mitchell, Nebraska.

ERWIN HARSCH, who until recently has been instructor in civil engineering at the University of Tennessee, recently resigned to take a position as junior engineer in the United States Engineering Department and is employed on a survey of the Arkansas River from Little Rock to the mouth, working under HENRY FOX, junior engineer, and under the supervision of LIEUT. COL. G. P. HOWELL, United States Corps of Engineers.

A. E. BERRY, formerly with James, Loudon & Hertzberg, consulting engineers at Toronto, is at present sanitary engineer with the Ontario Provincial Board of Health at its experimental station in Toronto.

GEN. WILLIAM H. BIXBY, who was elected President of the American Society for Testing Materials at the recent convention held in Atlantic City, was born in Charlestown, Mass., in 1849. A student for two years at the Massachusetts Institute of Technology, he was appointed to West Point and graduated from there in 1873.

Elected President of the American Society for Testing Materials



GENERAL WILLIAM H. BIXBY

Serving as assistant professor of engineering at West Point from 1875 to 1879, he graduated from the French Government School of Bridges and Highways in 1881 and became lecturer on coast defenses at the U. S. Naval War College in 1887. Sent by the Government to attend the French army maneuvers of 1880, he also examined and reported upon iron fortifications in Europe in 1881 and 1882. General Bixby has been in charge of U. S. River and Harbor Improvements in many states and has been in charge of lighthouse construction at many coast points. From 1905 to 1908 he was division engineer of the Northwestern and Western United States, and from 1908 to 1910 he was President of the Mississippi River Commission, being made chief of engineers, U. S. A. in 1910, retiring in 1913. On the outbreak of the war, General Bixby was ordered to resume duty, being placed in charge of the U. S. river and harbor improvements of the Kansas City district, with headquarters in Kansas City, but under a recent date his headquarters have been transferred to St. Louis. General Bixby is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the British Institution of Civil Engineers, the French Society of Civil Engineers, the U. S. Naval Institute, the U. S. Military Service Institution, and the British Association for the Advancement of Society. He was President of the Philadelphia Congress of the International Association of Navigation Congresses in 1912, and a member of the Executive Committee of the Pan-American Scientific Congress in 1915.

E. G. TEGTMEIR, former deputy county engineer, Snohomish County, Washington, has been appointed city engineer of that city.

F. L. HARGETT, formerly assistant resident engineer in charge of road improvements at Monroe, La., has been made superintendent of roads and bridges of Bowie County, Texas, with headquarters at Boston, Texas.

E. R. GRAY, formerly deputy city engineer of Hamilton, Ont., has been appointed city engineer of that town, having under his charge the waterworks and sewage-disposal plants.

B. E. MITCHEL has succeeded H. JOHNSTON as city engineer of Kitchener, Ont.

GEORGE MCKNIGHT recently resigned as city engineer of Fredericton, New Brunswick.

JOSEPH RICHARDSON has recently opened an office for general marine-engineering practice at 11 Broadway, New York City. Mr. Richardson will undertake marine survey work, the repair of vessels, the design and construction of shipbuilding plants and the design and construction of mechanical equipment for both vessels and plant.

BEARDSLEY LAWRENCE, formerly with J. B. Byrne, contracting engineer, of Boston, has opened an office as consulting engineer, at Wiscasset, Maine.

GEORGE BALLANTYNE has been selected to act as supervising engineer on the construction of a branch line from Niles to San Jose for the Western Pacific Railway.

G. W. WHITEZELL, having completed the erection of a three-story factory building for the Pennsylvania Salt Manufacturing Co., is again acting as superintendent for Schutz, Schreiner & Clyde Co., on the erection of a five-story office building in Pittsburgh.

E. E. THUM has resigned as assistant professor of metallurgy in the University of Cincinnati and is now associate editor of *Metallurgical and Chemical Engineering*. Previous to Mr. Thum's connection with the University of Cincinnati he was engineer in charge of construction at various smelting plants of the Anaconda Mining Company.

EDWARD C. SEIBERT has resigned as instructor in civil engineering at Pennsylvania State College and has accepted a commission as assistant civil engineer, United States Navy.

JOHN P. KELLY, formerly the senior member of the contracting firm of Kelly & Wheeler, Buffalo, N. Y., has formed the Kelly Engineering Corporation, with principal offices at Buffalo,

N. Y., and has at present the contract for installing the water-supply system for the borough of Ringtown, Pennsylvania.

C.-E. A. WINSLOW, Professor of Public Health, Yale Medical School, New Haven, Conn., has gone to Russia as a member of a Red Cross Commission, which will make a study of the needs of Russia as related to relief work.

GUSTAVE C. OLSEN has returned to the American Bridge Co. at Gary after having spent some time with the Baltimore & Ohio R.R. and with the Carnegie Steel Co. on the checking and fabricating of steelwork.

A. R. MCARTHUR, resident engineer of the American Sheet and Tin Plate Co. at Gary, Ind., has been appointed a member of the School Board of that city.

KARL W. BOCK has been appointed manager of the Walter A. Zelnicker Supply Co., St. Louis.

H. G. MCCORMICK has resigned as United States assistant engineer, Second Cincinnati (Ohio) District, and has entered the contracting business with the firm of Shipplett-McCormick Co., Inc., formerly the Shipplett Concrete Co., specializing in heavy concrete masonry. Mr. McCormick has been, for the last five years, in charge of lock and dam construction on the Kentucky River for the United States Government.

J. T. BARTRUG has been appointed chief engineer of highways of Lincoln County, West Virginia. Mr. Bartrug will maintain offices at Huntington.

JAMES NISBET HAZLEHURST, consulting municipal engineer, who has been working as chairman of the examining board appointed by the War Department to pass on the physical conditions of the cantonments sites of the Department of the Southeast, has been issued a commission as major, Engineer Section, United States Army Reserve Corps, and has been ordered into active service with headquarters at Atlanta, Georgia.

J. A. KITTS has recently accepted a position with the Great Western Power Co., San Francisco, and is at present in charge of construction on transmission lines. Mr. Kitts was formerly construction engineer on the Panama Canal, having charge of the precise setting of all machinery, lock gates and the construction of the electric towing railway at the Gatun lock. He recently completed the Spanish Peak Lumber Co.'s aërial tramway, on which he was field engineer for the American Steel and Wire Company.

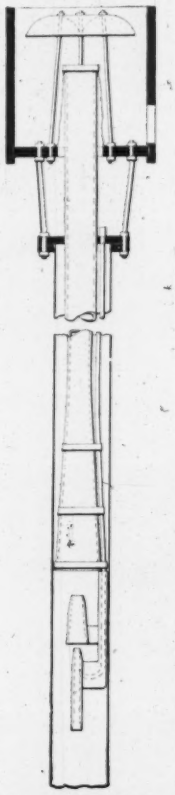
MAJOR E. J. DENT has assumed charge of the Seattle, Wash., Engineering District, relieving LIEUT.-COL. J. B. CAVANAUGH, Corps of Engineers, who was assigned to command the Eighth Reserve Engineer Regiment. Major Dent's duties include the fortification and river and harbor work along the coast of Washington.

Appliances and Materials

Air-Lift Foot Piece Increases Duty of Pump

A new combination of foot piece and delivery pipe for air-lift pumps is being made by the Talbot Air Lift Co., 18 South Seventh St., Philadelphia, and sold under guarantee to increase the water delivered per cubic foot of air by at least 50%. Actual tests are cited to show that the increased duty has averaged 100%.

The air-lift pump in its unmodified form dates back to the latter part of the eighteenth century, when it was proposed by Loescher, of Freiberg. Its first practical application in the United States was made in 1886. It merely consisted of a vertical pipe with its lower end submerged in a well and a smaller pipe delivering air into the bottom of it. The water became mixed with air and this light mixture consequently was raised above the height of the surrounding water. The additional aspirations created by the special design of the Talbot air lift lends additional advantages to this type of pump.



HAS NOVEL FOOT PIECE

The design is shown in the accompanying sketch. A hood is placed above the main nozzle to give a second aspiration; the shape of the bottom length of the delivery pipe is such that a third aspiration is effected. The delivery line is built up of wood staves and is tapered to keep the velocity constant as the water rises and the air expands.

High-Boiling Wood Preserver Made in America

Since 1914 the German supply of a high-boiling creosote wood preservative has been shut off. The Kettle River Co. now announces that it has installed stills to provide a coal-tar distillate above 300° C. to take the place of the former foreign product used for wood blocks, tank and brush treatments and marketed under the name of "C-P Wood Preserver." The new trade-mark is "K-R Wood Preserver," and it is claimed to have the same degree of toxicity and to pass the United States Signal Service and United States Navy specifications.

Boiler Compound Coats Metal

A new boiler compound that cannot clog steam pipes or cause other troubles traceable to the use of acids has recently been put on the market by the Boiler-Kote Co., of 343 South Dearborn St., Chicago. Neither have any vegetable products been used in the composition of this material, and therefore the claim is made that the formation of boiler crusts, which consist essentially of carbonate of lime, is not promoted. The product is a concentrated mineral solution that when introduced into a boiler, spreads itself evenly over the sheets, flues and tubes, coating them with a very thin glaze. To this glaze or film the scale cannot adhere. If a crust has formed, the solution passes through cracks in the deposit and, being raised to a high temperature on meeting the metal, forms an expanding deposit that forces the scale away and leaves a coating that will prevent more scale from forming. That portion of "Boiler-Kote" which does not attach itself to the metal passes off in the form of a harmless and odorless gas.

Circular Slide Rule for Figuring Reinforced-Concrete Slabs

A handy calculator for designing reinforced-concrete slabs, beams and girders of every description and for calculating the structural qualities of various kinds of wood has recently been put on the market by Kolesch & Co., New York City. In designing, the calculator simplifies the estimation of the size of reinforced-concrete plain and T-beams, the thickness of reinforced-concrete slabs, the reinforcement for plain and T-shaped concrete beams, the reinforcement for concrete slabs, the sizes of various kinds of wooden beams and the thickness of various kinds of wooden planks and boards.

In addition to the above it is equally useful in checking the safe load that any beam or slab of known size or span will carry, and for comparing the relative sizes of plain and T concrete beams. This requires no change of the disk's setting. The effect that the action of built-in beams of one span, as well as the continuous action of several spans, will have is easily determined; and a comparison of the relative size of concrete shapes with those of various kinds of wood is easily made. For ordinary multiplying and dividing, such as is carried on on the ordinary slide rule, this rule has the additional advantage that the result is pointed off.

All computations for concrete are based upon the Joint Committee recommendations, using the straight-line formula. The price of the rule complete with directions is $2.